

NATIONAL COMMISSION ON
AGRICULTURE
1976

ABRIDGED REPORT



सत्यम् वा नप्ते

GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE AND IRRIGATION
DEPARTMENT OF AGRICULTURE
NEW DELHI

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P R E F A C E

The National Commission on Agriculture presented its Report on 31st January, 1976. It is a comprehensive report on the progress and problems of Indian Agriculture including crop production, animal husbandry, fisheries and forestry and supporting research, education, extension, administration and other infrastructure facilities. A comprehensive report of this nature has been made over fortyfive years after the Royal Commission on Agriculture took a view of agriculture in the country in the twenties. The present Report is more broad based and takes note of the momentous developments in the entire field of agricultural technology, which have taken place during the last decade or so. It has tried to visualize Indian agriculture in the perspective of next twentyfive years and given broad indications of the directions of development.

2. The main Report consists of 69 Chapters in 15 parts. In its Report, the Commission had indicated that an abridged version would be brought out for "placing before a wider public the main features and a summary and conclusions of this Report." The abridged report is an attempt in that direction. In preparing this version, effort has been made to reflect the thinking of the Commission and most of its recommendations. Should it appear that there is any conflict of sense between the abridged version and the relevant passage of the main Report, the main Report has to be treated as the authentic document.

3. Before its main Report, the Commission had submitted to Government 24 Interim Reports. These Interim Reports dealt with issues of immediate importance or which were basic and of long term interest. In this abridged version while reference has been made to the Interim Reports wherever necessary, the rcommendations made in these Reports have not been repeated as such. However, the salient features of the important recommendations made in the Interim Reports have also been summarised and appended.

4. An additional feature of this Volume is that it also incorporates highlights of the Commission's Report issued at the time of its release to the public. This has been done with a view to providing a synoptic view of the Report.

5. The abridged version has been prepared in the Implementation Cell set up in the Department of Agriculture for overseeing the progress of implementation of the recommendations of the Commission.

(ii)

My thanks are due to all the Officers of the Cell and others who assisted in the preparation of this Report, as well as to the supporting staff for their conscientious effort in preparing this volume.

6. I hope that this abridged version of the Report will serve the needs of a large reading public.

NEW DELHI
APRIL, 1977

K. S. NARANG
Secretary to the Govt. of India
Department of Agriculture

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HIGHLIGHTS OF THE REPORT OF THE NATIONAL COMMISSION ON AGRICULTURE

1 INTRODUCTION

1.1 The Report of the National Commission on Agriculture was placed in Parliament on March 12, 1976. The Commission has also prepared Statewise reports on Rainfall and Cropping Patterns. Earlier, in pursuance of the terms of reference and at the request of the Union Ministry of Agriculture and Irrigation and the Planning Commission, the Commission had submitted twentyfour Interim Reports, on issues of immediate importance or which had a bearing on the formulation of the Fifth Plan.

1.2 The Royal Commission on Agriculture in India in its comprehensive Report published in 1928 made valuable recommendations for the improvement of agriculture and the rural economy. Since then, momentous events have changed radically the Indian economy and the agricultural scene. The Partition brought about an imbalance in the country's agricultural resource endowments. After Independence the Central and State Governments adopted the objectives of planned economic growth and social development. The introduction of the new strategy in mid-sixties in agricultural production ushered a new era of growth and social and institutional changes. In the context of this agricultural situation the National Commission on Agriculture was appointed on August 29, 1970 with wide ranging terms of reference particularly "to examine comprehensively the current progress of agriculture in India and to make recommendations for its improvement and modernisation with a view to promoting the welfare and prosperity of the people."

1.3 The key note of the Report, which is presented in 69 Chapters in 15 parts is the modernisation of agriculture through application of science and technology, keeping growth with social justice as the guiding principle. The Commission has spelt out the implications of establishing a prosperous egalitarian agrarian economy in a time perspective of 25 years. The potential of growth and employment opportunities in the various sectors of agriculture—crop production, animal husbandry, fisheries and forestry—have not only been estimated in quantitative terms but also been supported by detailed indications of technologies, policies and strategies, inputs and infrastructural and

2 HIGHLIGHTS OF THE REPORT OF THE NATIONAL COMMISSION ON AGRICULTURE

institutional development. The Commission has dealt with in detail the reorientation of research, extension and administration for the challenging tasks in the milieu of modernisation of techniques, rapid growth and social change. To impart a sense of urgency in the implementation of the recommendations, they have been presented in two time spans—the next decade up to 1985 and 25 years up to the turn of the century. In the following pages, the more important recommendations and observations of the Commission on different aspects of agricultural development are highlighted. Besides the aspects referred to, the Commission has dealt with other aspects like Centre-State relations in agricultural development, international co-operation, farmers' organisations, sericulture, apiculture, processing and agro-industries. The Report also gives a historical review of main policies and institutions since the Royal Commission on Agriculture gave its Report and has dealt with the progress of agricultural development and some economic aspects of agriculture.

2 OBJECTIVES AND POLICY

2.1 The Commission in its Report has envisaged a more dynamic role for the agricultural sector in the future and has focussed attention on its potential to become the leading sector in the country's economic development. It has pointed out that the agricultural sector has to grow at a rate much faster than before for the sake of the growth of the entire economy.

2.2 The Commission has said that to facilitate the establishment of a prosperous and egalitarian rural society, the agriculture policy should lead to (a) adequate supply of goods and services to sustain a rising standard of living and (b) sufficient employment and income opportunities for the masses which generate effective demand for these goods and services and enable them to enjoy the benefits of development.

2.3 The Commission has recommended that the main thrust of the policy should be to secure demand-supply balance in various agricultural commodities as well as distributive justice over a period of time. Investment policies should seek to allocate resources within agriculture to secure both efficiency in production and generation of maximum employment opportunities. It has stressed that in the choice of technology the labour surplus situation in the country should be kept in view. It has also advocated mobilisation of rural savings and their investment in the rural economy to facilitate sustained investment in agriculture.

2.4 For building a forward looking, dynamic and diversified agricultural economy, the Commission has recommended integrated development of crop production, livestock and poultry, fisheries and forestry and simultaneous improvement in all these fields. The production policy should be based on modernisation of agriculture, in which technology should, by far, be the most crucial input to make sustained and high growth rate possible.

2.5 Stress has been laid on diversification of production for ensuring availability of alternative foods including protective foods and raw materials and for increasing employment and income. In order to reduce nutritional deficiencies, much greater availability of animal protein should be planned for through livestock and poultry production and development of fisheries. Special care will have to be taken for improving the nutritional conditions of the vulnerable population groups.

2.6 An important observation made by the Commission relates to the nutritional norm. It has pointed out that an all India norm is unsuitable for judging nutritional deficiencies and defining poverty level in view of the regional variations in nutritional needs. It has suggested that norms should be determined by population groups and by States taking into account local dietary habits, climate and average bodyweight.

2.7 Dealing with inputs, the Commission has said that for realising the full potential of modern technology a package approach to the provision of services and supplies should be adopted. Regarding infrastructure development, an area approach has been suggested as being most effective and economical.

2.8 The Commission is in favour of regulating the use of machinery in agriculture so as to facilitate continuous progress towards full employment. It has said that farm power needs should first be met by manpower and draught animals. Mechanisation should be on a highly selective basis and may be allowed to bridge the power gap in areas exhibiting a marked shortage in man and animal power. In labour surplus areas suitable control will have to be used on the use of machinery.

2.9 The Commission has laid great emphasis on the maintenance of ecological balance and has cautioned against indiscriminate interference with the natural ecosystem in the anxiety to accelerate production and development. It has called for greater reliance on the use of renewable forms of energy and economy on the use of nonrenewable forms and suggested full use of recycling opportunities. It has recommended that a rural fuel supply policy should be adopted to promote conservation and recycling of all organic wastes.

4 HIGHLIGHTS OF THE REPORT OF THE NATIONAL COMMISSION ON AGRICULTURE

2.10 The Commission has stressed that while growth *per se* is important and a continuous growth and expansion of the economy must be planned, it is imperative that considerations of equity are built into the growth-oriented programmes. Agricultural development programmes recommended in the Report have, therefore, a positive slant towards social justice.

2.11 Salient social justice measures highlighted by the Commission include the creation of large scale opportunities for productive employment for raising the income levels of the weaker sections of the rural society through diversification of agricultural activities, promotion of subsidiary occupations and development of secondary and tertiary sectors in the rural areas. Land reforms and the reorientation of the service structure are the basic institutional changes recommended to enable the participation of the weaker sections in the production effort and the adoption of new technology. The Commission has said that sweeping changes are necessary in the service structure to make the new technology neutral to scale in practice.

2.12 Further, it has been stressed that the endowments of each region should be fully utilised in order to reduce regional disparity. Vulnerable and backward regions should receive special consideration in fixing priorities of development and in the matter of State assistance. It has also focussed attention on the socially undesirable effect of rural-urban disparity and suggested rapid development of the rural areas to tackle the problem of not only rural unemployment and underemployment but also urban unemployment.

2.13 The Commission has discussed in its Report the strategies needed for integrated, rapid and sustained growth and development in different fields of agriculture as well as the distribution of the benefits to the various sections of the community. The overall strategy recommended for enhancing production includes : (i) land and land use policy, (ii) continuous improvement in yield, (iii) increased availability and efficient use of scientific inputs, (iv) adequate support of research, education and extension, (v) simultaneous attention to the needs and potential of growth in areas with different levels of development and (vi) improving marketing and pricing structure.

2.14 The Commission has pointed out that coordinated development of the entire agriculture sector and optimum utilisation of the available resources on the lines suggested by it would enable the sector to grow at a rate sufficient to sustain a high rate of growth of the overall economy of the country.

3 DEMAND AND SUPPLY BALANCES

3.1 Estimates of per capita demand have been worked out on two assumptions of income growth (viz., "high" assuming an annual growth rate of 5 per cent and "low" assuming the continuation of past trends). Projections of demand have been made for a population growing to a level of 935 million in 2000 AD which takes into account the expected performance of family planning programmes. If the impact of the family planning efforts is greater than anticipated and the population turns out to be lower than that projected, the demand will be correspondingly lower. The present trend of world demand for food and raw materials indicates that there will be enough export avenues for the resultant surpluses of foodgrains and raw materials. If, on the other hand, the population growth is higher than that assumed by the Commission there will be potential for stepping up production of agricultural commodities to meet the higher levels of demand.

3.2 Supply possibilities of foodgrains and other crops have been assessed on the assumption that it would be possible to step up fertiliser consumption to 9 million tonnes and 14 million tonnes in 1985 and 2000 AD respectively supported by commensurate programmes in regard to other inputs and services. The Commission has, however, indicated that on the basis of past trends in fertiliser consumption, the offtake in 1985 would reach only 6 million tonnes which will give foodgrains production of 143 million tonnes. To match production with the low estimate of demand at 150 million tonnes, it would be necessary to step up fertiliser consumption to 7 million tonnes by 1985. However, if the target of income growth envisaged in the Draft Fifth Five Year Plan is realised, a demand of 163 million tonnes of foodgrains would be generated by 1985. To match production with this demand, fertilizer consumption would have to be pushed up to 9 million tonnes. At this level of fertiliser consumption under normal weather conditions, a production target of 164 million tonnes would be realised. Foodgrain production at this level would involve a tremendous effort particularly by way of extension and appropriate land policy to ensure necessary response of the farmers.

3.3 The outlook for some principal crops is expected to be comfortable even by 1985 and surpluses are expected in respect of commodities like sugar, gur, jute, mesta and tobacco. But in the case of vegetable oils, supply is not likely to catch up with expected demand in the coming years.

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3.4 The demand and supply balances for 2000 AD in respect of principal crops and vegetable oils are shown below :

Demand and Supply Balances—2000 AD

Item	Supply		Demand	
	Low	High	Low	High
Foodgrains (million tonnes)	230		205	225
Oils (million tones)	9.7		8.3	10.2
Sugar & Gur (million tonnes)	32.5	41.0	24.0	29.9
Cotton (million bales of 180 Kg. each)	24.0	29.3	10.4	17.2
Jute and Mesta (million bales of 180 Kg. each)	16.7		8.6	11.8
Tabacco (thousand tonnes)	692		479	590

3.5 If the programmes envisaged by the Commission in the animal husbandry, fisheries and forestry sectors are implemented, the country is expected to attain self-sufficiency by 1985 in respect of livestock products like milk, meat and eggs as also fish, fuel wood and industrial wood. The production of fish is expected to outstrip demand from that year onwards, thereby enhancing export possibilities. By 2000 AD, supply would more or less match demand in the case of milk, meat and eggs and there will be a substantial export margin in the case of fish and industrial wood as might be seen from the following table :

Demand and Supply Balances—2000 AD

Item	Supply		Demand	
	Low	High	Low	High
Milk (million tonnes)	·	·	64.40	49.4
Meat (million tonnes)	·	·	2.10	1.57
Eggs (million nos.)	·	·	27,882	17,419
Fish (million tonnes)	·	·	8.0	4.6
Industrial wood (million m ³)	·	·	71	47
				64

4 EXPORT STRATEGY

4.1 Diversification of exports both in terms of commodities and markets, assessment of the prospective demand in individual foreign

markets in terms of quantity and quality specifications, improvements in market research, financing facilities, packing and packaging and publicity are the measures suggested by the Commission to step up exports of agricultural and agro-based products. The Commission has pointed out that adequate arrangements for continuously providing information, market intelligence and statistics on various aspects of export marketing would be necessary. Export Promotion Councils should also be activated by strengthening their physical facilities and giving them some measure of autonomy in conducting market surveys.

4.2 In respect of selected export oriented commodities, integrated projects covering all aspects from specific production for export to processing, packaging and actual shipment have been suggested. Export strategy should particularly take into consideration the advantage which the country has in producing certain labour intensive crops and livestock products.

5 CROP PRODUCTION

5.1 The Commission had discussed various aspects of production and development of as many as 70 individual crops. A comprehensive scientific study of rainfall and cropping patterns at the taluk level was undertaken and the country divided into 62 rainfall regions. The cropping patterns in vogue in each region have been analysed, their suitability discussed and suggestions made for their modification to improve overall productivity. Suitable measures have been recommended for promoting the desired changes in cropping patterns.

5.2 For the crops studied, estimates of area and yield potential for 2000 AD have been indicated along with the measures necessary for achieving these levels. A broad idea has been given of the areas of research and development which will need special attention. An indication has also been given of the most appropriate rainfall regions for each crop on purely scientific considerations in order to maximise production.

5.3 The targeted yield and production levels of different crops for 2000 AD are based on the assumption that the cultivation of various crops would, by that time, be confined to the most appropriate zones and with the required backing of inputs like irrigation, quality seeds, fertilisers, plant protection chemicals, etc. and usage of appropriate implements and tools. Since all these factors are crucial to the attainment of the contemplated yield and production levels, any deviation from the cropping patterns or the levels of inputs and extension envisaged would result in the lowering of the targeted levels.

5.4 The Commission has emphasised the need for intensive and

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systematic land use planning since there would be tremendous pressure on this resource in view of the competing claims of not only crop production, animal husbandry and forestry but also the rapid urbanisation and industrialisation of the country. A balance sheet of landuse has been presented in two time perspectives, namely, 1985 and 2000 AD, which shows that the net area sown and gross cropped area are likely to increase from the present level to 145 and 181 million hectares (Mha) in 1985 and further to 150 and 200 Mha in 2000 AD respectively.

5.5 The total area under foodgrains is projected to increase from the present level to 127 Mha in 1985 and then decline to the base level of 123 Mha in 2000 AD. Due to increasing levels of productivity, it would be possible to obtain the targeted level of foodgrains production from 61.5 per cent of the gross cropped area as against 75 per cent in 1970-71.

5.6 On the other hand, area under commercial crops is likely to increase by varying extents. In 2000 AD, the likely area under these crops would be 25.5 Mha in the case of oilseeds, 5.0 Mha under sugarcane and 11.5 Mha in the case of cotton.

5.7 The genetic potential of the existing varieties of various crops is 3 to 4 times the present average yields. Taking into account the yield levels attained in Government experimental farms, national demonstration plots and the availability of inputs, etc., the Commission has estimated that by 2000 AD the yield levels would be 2 to 3 times the existing levels.

5.8 Based on the expected levels of availability of inputs and development of infrastructure, research, institutional and organisational efforts, the Commission has estimated that the level of foodgrains production that could possibly be achieved at the turn of the century would be around 230 million tonnes against the base level (1969-72) production of 104 million tonnes.

5.9 In the case of commercial crops, the production targets indicated are 26.0 million tonnes for field crops of oilseeds, 24.0 to 29.3 million bales (180 kg each) in the case of cotton (lint) and 32.5 to 41.0 million tonnes in the case of sugarcane (gur). It has also been estimated that the production of jute, mesta and tobacco in 2000 AD is likely to be higher than the base level by 165, 80 and 115 per cent respectively.

6 ANIMAL HUSBANDRY

6.1 The Commission has recommended that the main thrust of livestock development programme should be to improve the economic

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status of the weaker sections of the society such as small farmers, marginal farmers, landless agricultural labourers, nomadic tribes and other tribal population while, at the same time, obtain significant increases in production. Keeping this in view, the objectives of animal husbandry programmes should be to (a) obtain adequate supply of milk, meat and eggs and other useful animal products and byproducts; (b) improve the economy of the producers, particularly those belonging to the weaker sections of the rural community; and (c) create additional employment opportunities. These objectives are to be achieved with extensive rural livestock development programmes for rapid increase in livestock production on a commercial basis through application of science and technology and provision of necessary inputs and services in a package form through farmers' organisations preferably cooperatives. The inputs and services essentially required are superior breeding stock, balanced feeds and fodders, efficient health cover and provision of institutional credit and remunerative market for the products.

6.2 The Commission has laid emphasis on improving milk characteristics of cattle through crossbreeding with exotic dairy bulls, and by selective breeding and grading up in case of buffaloes. The Commission has brought out the potentiality of developing the buffalo also as a meat animal. The serious problem of acute overstocking of land is mainly related to the enormous number of cattle, generally of extremely poor quality. The Commission has, therefore, recommended that along with the genetic improvement of cattle, steps should be taken for decreasing progressively their number. By implementing the cattle and buffalo development programmes, it would be possible to meet the demands of milk and working animals from about 168 million cattle by the year 2000 AD as against the present cattle population of about 179 million; there is also a possibility of a marginal decrease in the number of buffaloes.

6.3 One of the most serious difficulties in development of livestock is the acute shortage of feeds and fodders. Only two-thirds of the fodder and one-fourth of the concentrates required for providing adequate nutrition to the present animal population are available. The Commission has suggested measures that should be taken for bridging the large gap between the requirements and availability of feeds and fodders and has indicated the steps necessary to meet fully the requirements of the genetically improved stock.

6.4 For development of dairying, the Commission has recommended that the organised sector should attain a dominant position in the urban milk markets by capturing a major share of the markets, and handle about 90 per cent of the anticipated urban milk demands

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in 1985. For this purpose the capacity of annual throughput of the urban milk plants will require to be enlarged to 7.2 million tonnes from the present installed capacity of about 3 million tonnes. The legal and fiscal measures as also the incentives and organisational changes necessary for promotion of dairy industry have also been indicated.

6.5 The Commission has recommended the introduction of exotic inheritance in the indigenous stock of sheep and pig for increasing production through genetic improvement. The development of sheep has been emphasised for meeting the requirements of both mutton and wool. For this purpose the present population of about 40 million should be raised to about 45 million by 1985 and 60 million by 2000 AD. The Commission has recommended that the goat population should be gradually reduced from the present number of about 70 million to around 40 million by 2000 AD in view of their destructive role to vegetation.

6.6 According to the Commission, a serious weakness in the poultry industry is its dependence for procurement of high quality hybrid chicks through the franchise hatcheries. Deficiencies in marketing organisations are other constraints in the way of rapid development programmes. Licensing of hatcheries to overcome the spread of poultry diseases is necessary. Measures to remove these inadequacies have been recommended.

6.7 As an essential requirement of livestock development, the Commission has laid great emphasis on the organisation of efficient veterinary service. It has been recommended by them that the present free but inadequate service for animal health protection should gradually be replaced by paid service with a continuous parallel effort to improve the quality of service. It has further been recommended that private practice by veterinarians should be encouraged. At present there is only one veterinarian for every 26,000 cattle units. The Commission is of the opinion that there should be at least one veterinarian for every 20,000 cattle units by 1980, 10,000 cattle units by 1990 and 5000 cattle units by 2000 AD. However, in areas of intensive livestock production, it would be necessary to have one veterinarian for every 10,000 cattle units from the Fifth Plan period itself. In order to improve the quality of veterinary services, the funds of the Veterinary Departments should be supplemented by introducing a phased programme of levying a charge for the treatment of livestock including prophylactic vaccinations. However, the services rendered and the biologicals used under the national programmes of diseases control and eradication and vaccination work to control epidemics in the event of natural calamities should be carried out

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free of charge by the State. The Commission has suggested that the State Biological Production Centres should be converted into corporations and run on commercial lines. In consideration of serious hazards of diseases communicable from animals and animal products to man, the urgency of setting up a Veterinary Public Health Service has been stressed. Programmes for modernising slaughter houses and for setting up a chain of carcass utilisation centres have been outlined.

7 FISHERIES

7.1^o The Commission has reviewed the potentials of fisheries—marine, inland and aquaculture—and has recommended stepping up of production with necessary research and administrative support. A fourfold increase of fish and shellfish from 1.9 million to 8.0 million tonnes is visualised by 2000 AD. It has felt the need to attain this target, so that the per capita availability of this low cost protein food could be raised from 4 kg/ annum to the minimum nutritional requirement of 11 kg/ annum. It is estimated that 6.75 million tonnes will be consumed as fish, about 0.25 million tonnes exported and about 1.0 million tonnes utilise for industrial fishery products. Specific recommendations have been made on Crustacean fisheries, particularly prawns, because of their singular importance in the economy of Indian fisheries, constituting 90 per cent foreign exchange earnings of about Rs. 100 crores from marine products in 1975.

7.2 For raising inland fish production, the Commission has suggested intensive fish culture of Indian indigenous carps together with compatible exotic species to give the highest yields. For this the most urgent need is to produce many times more seed fish than what is available at present. The coastal and estuarine waters could be made equally productive by the intensive stocking of estuarine species. The collection of seed of fish and shell fish for stocking should also be intensified. The yield of fisheries of reservoirs, which is about 5 kg per hectare, should be raised at least to 40 kg and the average yield from smaller bodies of water should reach at least 3000 kg per hectare to make fish culture a remunerative industry.

7.3 For marine fisheries, the Commission has emphasised the need for medium sized vessels to exploit the seas within 320 km zone rather than distant water fishing fleets. In view of the heavy capital and operating cost of mechanised vessels, the need to select efficient smaller boats of lower horse power for coastal operations has been stressed instead of over-capitalisation on larger vessels. Attention has been focussed on the importance of developing fisheries.

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harbours and the large number of medium and smaller fish landing places for mechanised boats as an immediate step forward in the modernisation of fishing. Further, the need to step up tuna fishing in high seas and processing has been emphasised for which foreign assistance may be sought to augment indigenous expertise. Restructuring of marine fishery exploratory and research fleet has been suggested to bring together the exploratory and marine research programmes.

7.4 The Commission has indicated the vast potential of Crustacean fisheries and the need to develop it on sound lines to derive the maximum benefit without damaging the stocks. The present system of decision making in different Ministries over this valuable resource is sought to be replaced by a Central agency which will closely foster and monitor production, processing, trade, quality and exports. In the export trade the need for diversification of products and markets has been particularly stressed.

7.5 The detailed measures necessary for improving the infrastructure for marketing of fish within the country have been suggested, particularly those based on "insulated" transport system supported by large number of cold and freezing storage plants rather than investment on refrigerated transport. The needs of personnel in fisheries have been broadly assessed and indications given for stepping up training and education facilities. The Commission has devoted particular attention to the requirements and problems of small fishermen and has suggested measures for involving them in programmes for increasing production and marketing their produce.

8 FORESTRY

8.1 In the view of the Commission, forestry development should be designed to meet the economic demand for forest products and maintain and improve the quality of the environment as well as provide substantially increased employment in forestry operations, particularly to the weaker sections of the society. Programmes and other organisational steps needed to achieve this goal have been indicated.

8.2 The Commission has suggested a revision of the National Forest Policy and the adoption of the revised policy by the State Legislatures for ensuring the planning of forest programmes on firm lines based upon the needs and interests of the people.

8.3 The Commission has strongly recommended that there should be no reduction in the present area under forests and no deforestation should be done without the approval of State Legislatures.

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Where it is absolutely unavoidable, an equivalent area should be afforested elsewhere.

8.4 Social forestry can be the only practical step for increasing the area under forests and treelands. Under farm forestry, farmers should be encouraged to plant more trees in the farm lands on the bunds on the boundaries of their fields, which will also serve as windbreaks against soil erosion. Under extension forestry, plantations should be taken up on canal sides, road sides and ravine lands, and shelter-belts should be created in vulnerable areas. The rural people should be made aware of their responsibilities in affording protection to forests and grasslands to be developed for use by them.

8.5 To enable intensive management, the Forest Departments should be provided with funds not only for extraction of forest produce but also for regenerating the field areas. It should be recognised that there can be no right to fell a forest, unless adequate funds are available for its regeneration with a view to realising a higher productivity in the years to come.

8.6 The Commission has recommended the tightening of forest laws as well as an economic approach for tackling the problem of encroachments on forest lands, illicit fellings and grazing. It has suggested control of grazing and linking of development of grasslands and fodder resources in the forests to livestock improvement programme.

8.7 The Commission has reiterated its recommendations made earlier in its Interim Report on Production Forestry—Man-made Forests for substantially stepping up production from forests. For increasing production from forests without upsetting the protection and aesthetic aspects, detailed indications have been given on how to synthesise the protection and social functions of the forests with that of production.

8.8 The Commission has emphasised that while preparing project plans, the creation of local employment opportunities at reasonable minimum wages should be specially planned. The existing system of harvesting forest produce through contractors should be replaced by direct employment of local labour or forest labour cooperative societies or a combination of both.

8.9 Stress has been laid on the role of the Forest Departments in improving the living conditions of the weaker sections of the population, even while developing minor forest produce as a commercial activity. The necessity of affording adequate protection to wildlife has been emphasised.

8.10 The Commission is of the view that the existing organisations at the Centre and in the States need to be strengthened for dynamic

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forest development and wild life management. Necessary recommendations in this regard have been made.

9 RESOURCE DEVELOPMENT

9.1 For the first time, the Commission has made a quantitative assessment of water in the various stages of the hydrological cycle in the country. It envisages that it may take about 50 years for the full development of water resources. At that stage, three-fourths of them would be utilised for irrigation and the rest for other purposes. On full development by 2025 AD, about 110 Mha would be irrigated in an expected cropped area of 210 Mha. Thus nearly half the cropped area would ultimately remain rainfed as against about three-fourths at present. The Commission has dealt with irrigation policies at some length and *inter-alia* has recommended that some water should be taken, even at a sacrifice, from water affluent to water paucity areas. Ultimately, of the total irrigation, one-third shall be from groundwater and two-thirds from surface water. The Commission has emphasised that while according priority to groundwater development, the pace of development of surface water must not be slackened. In view of the overall inadequacy of water resources for irrigation, it has laid stress on efficient water management and on lining of channels to reduce seepage losses.

9.2 The Commission has highlighted the importance of expeditious development of command areas on new projects and has suggested a programme for making up the existing backlog of 10 Mha on projects already completed. It has suggested that land formation, construction of watercourses, field channels, field drains and farm roads should all be taken up together by Land Development Corporations and carried out along with consolidation of land holdings. It has expressed the view that an irrigation project should not be considered complete unless its command area is also developed. The Commission anticipates that the required finances for command area development would be forthcoming from financial institutions without any difficulty; but it has urged that all efforts should be made to build up an organisation capable of developing command areas at a pace of one million hectares per annum by 1980 and 1.4 Mha per annum by 1985.

9.3 The Commission has examined the possibility of augmenting land for cultivation either by recovering it from other less important uses or improving those which have become unfit due to wanton use by man and animal. Besides indicating the magnitude of the problems posed by waterlogging, salinity, alkalinity, aridity and erosion in

various parts of the country and causes which brought about the degradation, the Commission has spelt out the ways and means of improving the situation. Likewise the Commission has dealt with conservation in the catchment of river valley projects and in cultivated lands in rainfed areas and has outlined the measures to be taken there.

9.4 The Commission has highlighted the role of electricity in the development of rural economy, particularly in crop production. It has recommended that in areas where power shortage may occur, the requirements of the agricultural sector should be met on a priority basis.

10 CREDIT, INCENTIVE AND SERVICES

10.1 The Commission has emphasised the need for an integrated agricultural credit service covering all aspects of rural development including production, marketing, transport and processing and providing the requisite credit with the facility for its conversion into production inputs and investments in resource development.

10.2 The Commission envisages greater involvement of commercial banks in financing agricultural development. It has indicated that the share of agricultural advances to total advances by them should rise from 8.8 per cent in 1974 to 15 per cent in 1985. The Commission has recommended that the Reserve Bank of India and the Government should immediately initiate planning for business and manpower development in the institutional agencies to equip them for undertaking such a programme.

10.3 A broad assessment of the requirements of credit up to 1985 made by the Commission for all categories of farmers places the need at Rs 9,400 crores, which is considered to be well within the capacity of the cooperative and commercial banking system. The estimate has been arrived at after applying the principle of graduation recommended by the Commission, which envisages the farmers to graduate to self-sufficiency over a period of time as regards the requirement of working capital.

10.4 The Commission has suggested greater weightage to the needs of small and marginal farmers and provision of credit to them on preferential terms in respect of both interest charges and quantum of advances to enable them to upgrade and modernise agriculture.

10.5 Suggestions have also been made for improvements in farmers' service societies, the groundlevel organisation recommended by the Commission in its Interim Report, in the light of their record of performance.

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10.6 Discussing other incentives, the Commission has recommended that subsidies should be allowed selectively to those classes, sectors and key programmes that need support in the interest of balanced and quick development and in keeping with the objective of growth with social justice. The types of awards and social recognition to be accorded to the farmers for augmenting production have also been discussed.

10.7 The need for modernising and streamlining the existing marketing structure and practices has been emphasised. The primary effort in the immediate future should be for regulating all markets and bringing all agricultural commodities within the purview of grading and marking system. There is need for research in improving pre-harvest treatment of crops and prevention of post-harvest losses and for strengthening of infrastructure for storage and transport. Both marketing and processing functions have to be brought increasingly within the fold of the cooperatives.

11 RESEARCH

11.1 There are three categories of research viz., fundamental, applied and adaptive, which have been defined and the responsibilities amongst the various agencies for deriving optimum benefits have been apportioned. The responsibilities of research and development in agriculture lie mainly with the agricultural universities, the ICAR, research institutes and the State Departments of Agriculture. The academic climate of the agricultural universities being the most congenial to the pursuit of knowledge, they should be entrusted with fundamental and applied research. The infrastructure of the Central research institutes is also considered congenial for basic and applied research. The State Departments of Agriculture are the most competent, in view of their wide jurisdiction and availability of adequate resources, for carrying out adaptive research which requires extensive experimentation on the economics and adaptability to agroclimatic regions. Each of the organisations should accordingly be adequately strengthened with men, materials and facilities. There should be appropriate mechanism for coordination and cooperation amongst the various agencies, so that the total impact of research is effectively felt in the overall increase in production and productivity.

11.2 The ICAR should, with the help of its scientific panels, undertake to draw up long term plans of fundamental and applied research, identify gaps in information and assign them for execution to appropriate scientists, universities and research institutes. *Ad hoc*

schemes on research basic to agriculture emanating from the universities should be liberally funded. The ICAR should concentrate more on problems of national importance and develop suitable coordinated programmes, provide funds and evolve mechanics of coordination. All research work of local importance should be carried out by the agricultural universities and the State Departments through their own organisations. A fresh look is necessary with regard to the all India coordinated research projects in respect of their criteria, location, funding, administration, evaluation and follow-up.

11.3 The ICAR research institutes should be spread evenly over the different agroclimatic regions. For this purpose they should preferably be of small and medium sizes having more specific and restricted objectives, so that manageability and viability are assured. Research management requires specialised training which every head of an institution should acquire. Now that agricultural universities have come into existence in good numbers, the ICAR institutes need not have any regular academic programmes like the teaching and degree-awarding activities. They should also refrain from any commercial production but restrict themselves to researches on development and perfection of the products.

11.4 The ICAR has recently introduced cadres of Agricultural Research Service. For the initial induction the candidates for Agricultural Research Service should possess research experience and evidence of research capability making it necessary to raise the age of candidates to 28 years. The impact of this innovation on the quality of research output should be watched and evaluated over a period of time before any further changes are introduced.

11.5 The Central Government should liberally fund research work in agricultural universities, not on a *pro rata* but rather on the basis of need, to enable them to come up to a desired level. Research and development funding in agriculture is at present inadequate. This should be raised in a phased manner in such a way that in course of ten years or so it constitutes about 1 per cent of the contribution which the agricultural sector makes to the Gross National Product. Ten to twenty per cent of the total plan outlay under agricultural development programmes should be earmarked in the State budget for agricultural education and research.

11.6 In view of the need for intensifying researches on animal production aspects, the Commission has recommended setting up of research institutes on animal genetics, animal nutrition and poultry.

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12 EDUCATION AND EXTENSION

12.1 An agricultural orientation at primary and secondary school levels has been emphasised. There has been appreciable thrust on agricultural education at the higher levels but that at lower and middle levels has been neglected. The need for trained men at the latter levels is enormous having a high potential for employment. To ensure proper attention in this direction, vocational training and nondegree and nonformal education in agriculture have to be organised on a massive scale.

12.2 The ICAR should insist on the creation of an inter-university task group which would study the employment opportunities of agricultural graduates and formulate necessary action programmes. The agricultural universities should act as a link between their graduates and the prospective employers.

12.3 For comprehensive and integrated university education in animal science, courses of study in animal production, veterinary science and animal products technology should be designed for awarding degrees independently in these disciplines at Bachelor's and Post Graduate levels. Animal science educational programmes should be developed in agricultural universities under a single faculty. A thorough revision and recasting of curricula and syllabi would be required for introducing the reorganised educational programmes. In order to ensure high standard of education in animal science, agricultural universities should allocate adequate funds.

12.4 As a part of agricultural education, fisheries education should be imparted in the agricultural universities. The ICAR may select a few universities for supporting fisheries education, only agricultural universities for inland fisheries on a regional basis, and the universities of Cochin, Bombay and Mangalore College of the University of Agricultural Sciences, Hebbal, for marine fisheries. Courses in fisheries at universities should be opened only after careful examination by expert groups constituted by the ICAR. The graduate level courses can develop on a regional basis, depending on the special needs of the region where a university is located, but the postgraduate courses should have an all India basis, in order to provide for recruitment, placement and inter-changeability of personnel at senior levels.

12.5 Extension of results of agricultural research should be based on well laid out demonstrations. For this purpose the National Demonstration Programmes should be streamlined. Farmers trained under Farmers' Education and Training Programme should be involved

in extension work. Such programmes should specifically include the training of women in the rural areas. Education and training of women, which constitute bulk of the rural population in the agricultural sector, at the middle and lower levels should receive special attention. To maintain an efficient band of trained personnel, in-service training should constitute an important part of agricultural education. At least one Farmer Training Centre for every 15 blocks would be a desirable approach. Special curricula bearing on subsidiary occupations, nutrition and food habits and population education should be introduced in the case of women trainees. For this purpose a separate wing under the supervision of trained women staff should be set up in the training centres. It will be necessary to put across special broadcasts for women. The *Mahila Samities* organised under the Applied Nutrition Programme can be suitably expanded to enable them to act as a discussion forum for women. The sections of home science and nutrition education in the Directorate of Extension in the Centre should be suitably strengthened so that they can provide a desirable national leadership. All such programmes handled by other departments and universities should be brought into its fold.

12.6 The Departments of Agriculture/Animal Husbandry/Fisheries at the State level should have overall responsibility for extension work and should also be responsible for suggesting field problems and formulating new farm technology, conducting field trials and demonstrations, a common information cell along with the agricultural university, organisation of training programmes, etc.

12.7 The Central Directorate of Extension will be responsible for coordinating extension and training activities in the country, and laying down the broad principles for the nation in the field in consultation with the States. The Central agency should also conduct sample assessment of the extension and training programmes with a view to drawing conclusions of value for improvement of these programmes. It should maintain upto date data on manpower requirements in the context of development programmes.

13 RURAL EMPLOYMENT

13.1 According to the Commission's projections, the rural labour force will increase by about 111 million in 30 years from 139 million (excluding children) in 1971 to 250 million in 2001 AD. For providing gainful employment to the rural labour force the Commission has suggested a two-pronged strategy consisting of (a) maximisation of employment potential in the various agricultural programmes and (b) full exploitation of the employment potential in non-agricultural

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rural activities. The entire rural development plan should be employment oriented and detailed employment planning done at the micro level. The Commission has said that the creation of employment opportunities should not be left to *ad hoc* programmes.

13.2 The Commission has estimated the generation of 52 million man years of additional employment through agricultural programmes by 2000 AD, an increase of about 60 per cent over the level in 1970. Of this additional employment, roughly two-third is from crop production and irrigation, and a little less than one-fifth from animal husbandry, the balance being accounted for by fisheries and forestry programmes.

13.3 The Commission has indicated that at least 30 per cent of the rural labour force should be provided employment in the non-agricultural rural sector compared with 15.5 per cent at present. This would amount to creating 53.5 million man years of additional employment opportunities. It has recommended a number of steps to increase nonagricultural rural employment opportunities, which include development of infrastructure, promotion of rural industries, decentralisation of appropriate manufacturing industries and development of packaging, processing, marketing and trade in the rural sector. It has also suggested that production of more sophisticated processed foods should be decentralised and employment opportunities in such industries reserved for the rural sector as a national policy.

13.4 The Commission has further pointed out that it would be reasonable to assume an optimum of 265 days per year as a measure of full employment in 2000 AD instead of 300 days on which its calculations have been based. Keeping this in view, the Commission expects adequate employment opportunities for the additional labour force in the rural sector itself.

13.5 The Commission has emphasised that a reasonable level of minimum wage should be ensured along with employment to enable the class of agricultural labourers to move above the poverty line. Considering that the average productivity in the agricultural sector is expected to double itself by 2000 AD, it will be possible to ensure a fair minimum wage to the agricultural labourers.

14 SPECIAL AREA PROGRAMMES

14.1 In its Report the Commission has specially discussed the needs of backward and underdeveloped regions in the country. The areas covered include the Himalayan hill regions in the northern and north eastern States and Western Ghat areas, tribal areas, desert and droughtprone areas including the cold desert, and the Kutch area in

Gujarat and Sundarban in West Bengal. The Commission has pointed out that these areas require special programmes of development.

14.2 The Commission has given its views on the broad strategy of agricultural development in these areas and recommended an integrated area development approach. Stress has been laid on adequate infrastructure development to support agricultural improvement.

14.3 Dealing with hill areas, it has indicated that resource development programmes in the hill areas should be adequately supported by essential infrastructural facilities. In these areas development of forestry, pastures and high value crops including horticulture as well as livestock and poultry has been stressed. In the Western Ghats, the order of priority suggested is forestry, plantation and livestock development. The Commission has pointed out that a change in the pattern of production to optimise economic return should be followed by arrangements to provide foodgrains through controlled channels from other parts of the country.

14.4 Discussing the development strategy in tribal areas, the Commission has suggested that in formulating development programmes a distinction should be made between areas which are easily accessible and already exposed to a market economy and those which are not, as they present different possibilities in the near future. High priority has been recommended for the solution of the land problem and the preparation of authentic land records. The Commission has suggested itinerant courts to settle land disputes and provide debt relief on the spot.

14.5 Commenting on the Drought Prone Areas Programme (DPAP) the Commission has said that since the factors taken into account for determining the areas requiring special assistance are continuously changing, the coverage of DPAP should be reviewed from time to time and areas where substantial improvement in irrigation occurs should be excluded. The Commission has also stressed the need for diverting surplus water from other river basins to drought affected districts to supplement local availability and give a minimum support.

14.6 A comprehensive research in the cold desert areas of Ladakh and semi-arid areas of Himachal Pradesh has been recommended to be taken up by the ICAR.

14.7 Referring to the Little Rann of Kutch, the Commission has suggested that the feasibility of bringing water there to control salinity should be considered for developing brackish water fisheries. A pre-investment survey in selected areas has been recommended.

14.8 An integrated development of crop production, fisheries,

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forestry and animal husbandry as well as infrastructural improvements and supply of potable water have been recommended for Sundarban area. The Commission has commended the engineering and other measures proposed under the development plan of the area.

14.9 Discussing about special assistance to small and marginal farmers, the Commission has recommended that due to the special circumstances in the desert districts, the limit of land holdings for determining eligibility for special assistance should be kept flexible in order to cover a minimum of 20,000 cultivating and agricultural labour households in each district. In areas where the number having holdings below 2 hectares exceeds the minimum, the existing definition should apply.

15 ADMINISTRATION, PLANNING AND STATISTICS

15.1 The Commission has reviewed the administrative requirement for supporting a rapid development of scientific agriculture and suggested several changes in the administrative set-up in the field of agriculture, both at the Centre and in the States.

15.2 The Commission has recommended a direct and single line of control from the field to the State level and coordination in the agricultural sector through a senior technical officer belonging to one of the agricultural disciplines. It has emphasised that the crucial operational level in the case of agriculture is the district. In each district, there should be a senior officer, to be designated as Chief Agricultural Development Officer (CADO), to coordinate the activities of all agencies working for agricultural development in the district. He will function under the administrative control of the Agricultural Production Commissioner. At the block level also, there should be a counterpart officer viz., the Block Agricultural Development Officer (BADO) for coordination. The Commission has further recommended that out of the 10 VLWs in the block, 8 should be earmarked exclusively for agricultural extension. The number of VLWs will have to be trebled and that of AEOs increased suitably to provide an adequate extension infrastructure. Where the Zila Parishad is effective, the district field organisations may be placed under its control. The Commission is of the view that the District Collector should not have administrative control over the agricultural officers and should not be concerned with their detailed working.

15.3 The Commission has recommended, that at the State level, there should be separate secretariat departments at least for crop production, animal husbandry, fisheries and forestry in all major States. The Agricultural Production Commissioner-cum-Principal Secretary,

who should be next in rank to Chief Secretary, should be responsible for overall planning, coordination and guidance. It has been recommended that at the level of ministers, a senior Cabinet Minister, who should be Deputy Chief Minister in the State Cabinet, should assume overall responsibility for agricultural development.

15.4 Referring to the setup at the Centre, the Commission has recommended that there should be 9 departments in the Ministry under the charge of the Secretaries viz., agriculture, crop production, animal husbandry, fisheries, forestry, irrigation, rural development, research & education and food. The Ministry should have a Principal Secretary for coordination, who should also be in charge of the Department of Agriculture which will deal with important functions common to the different departments. It has also recommended the strengthening of several subjects-matter divisions in the Ministry and upgrading the status of technical officers like Animal Husbandry Commissioner, Agricultural Commissiner etc.

15.5 It has been recommended that the secretariat proper, both at the Centre and in the States, should be small and compact establishments and technical officers should be delegated full responsibility for administration of programmes. Top management posts in the secretariat including those of Secretaries and Joint Secretaries should be held by technical officers. To facilitate expeditious decisions and implementation of programmes, the heads of technical directorates should be given ex-officio secretariat status.

15.6 The Commission has recommended the formation of an All-India Agricultural Service to provide suitable career incentives. Stressing the need for a channel for flow of technical officers from the States to the Centre, it has suggested that the Central technical posts should generally be filled by deputation from the States.

15.7 The Commission has emphasised the need for strengthening the Planning Division at the Centre in the Ministry of Agriculture and Irrigation and the organisation of strong units for planning, coordination and evaluation at the State and district levels.

15.8 To facilitate decisions on key issues of overall importance and assessment of progress of development, the Commission has suggested the constitution of consultative machinery at various levels consisting of Ministers, technical and secretariat officers and other concerned interests. The formation of District Agricultural Coordination Council, Joint Councils under the respective departments at the State and Central levels and Agricultural and Rural Development Councils at the State level as well as a Standing Consultative Council at the Centre have been recommended.

15.9 The Commission has emphasised the need for building up a

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highly competent organisation with expertise in mass communication and ability to make appropriate use of mass communication media. It has recommended that the Directorate of Extension at the Centre should be strengthened and placed in the Department of Agriculture under the Principal Secretary. The Directorate should be the source of technical guidance and advice regarding extension organisation, extension training and communication and should be headed by an Extension Commissioner, who should be a technical officer of the rank of Additional Secretary.

15.10 The Commission has suggested some urgent and essential organisational and directional changes in the planning process and reorientation in the outlook of the planning machinery in the agricultural sector at different levels. A careful review has been suggested of the current procedures with a view to decentralising the power of decision making as far as possible.

15.11 For fuller development and utilisation of local resources as also the involvement of all sections of the community, the Plan has to develop from the village level to concretise in the form of projects/programmes in the different watersheds and agroclimatic regions which could be properly coordinated and integrated at the State level within the framework of the national Plan.

15.12 While emphasising the need for strengthening the planning machinery at various levels for the formulation of plans, the Commission has suggested that an effective evaluation system would also be essential to keep a watch on the progress of schemes and for keeping the implementation agency adequately and promptly informed of difficulties and bottlenecks for taking necessary corrective measures. Apart from evaluation and appraisal by Government departments, evaluation through independent autonomous bodies like the agricultural universities and research institutions should also be encouraged.

15.13 A number of measures have been suggested for improving the present status of agricultural statistics to subserve the needs of administration, planning and policy formulation. For radical improvement in the system, the Commission feels that it is necessary to have a professionally competent, fully trained and unified statistical organisation from the level just above the Patwari and/or Kanungo right up to State and Central levels.

16 AGRARIAN STRUCTURE

16.1 The Commission has pointed out that the reordering of the agrarian structure is an essential precondition for the establishment of a prosperous and egalitarian rural society. The land policy should

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ensure intensive cultivation of land, generate widespread productive employment and reduce disparity. It should induce changes in property relations and the structure of rural economy and society.

16.2 In the Commission's view, agriculture should be a family occupation of the peasant cultivator and should not be a source of subsidiary unearned income. Tenancy reforms should be directed to break up landlord tenant nexus with minimum exceptions. Leasing out of land by bigger landowners should be prohibited. All tenants of landowners possessing land over marginal holdings should be declared owners with heritable and transferable rights, except bigger landowners who leased in land from the small landowners. Leasing out of land should be permitted only in the case of marginal farmers and a few exempted categories of persons because of their special circumstances. Sharecroppers, who are hitherto not recognised as tenants, should be recognised as tenants.

16.3 The Commission has recommended the imposition of ceilings on operational holdings in addition to the existing ceilings on ownership holdings. It has also stressed that the current ceiling laws regarding ownership holdings should not be disturbed for a sufficiently long time to encourage investment in agriculture. The Commission has advocated firm measures in close cooperation with local committees to deal with clandestine and *benami* transfers so as to vest appreciable areas and make them available for redistribution.

16.4 Stressing the need for speedy implementation of the land reform measures, the Commission has suggested the separation of land reform administration from land revenue administration and the creation of special land reform agencies composed of specially trained and handpicked officers, who would work in close collaboration with the local committees of the beneficiaries. Special itinerant courts have been suggested to expedite the implementation of ceiling legislation.

16.5 Dealing with consolidation of holdings, the Commission has recommended that land reforms should precede consolidation to protect the interests of tenants and sharecroppers. Consolidation operations should be given high priority in irrigated areas and command areas of irrigation projects. They should be time-bound, not stalled by civil litigations and made compulsory in areas fit for consolidation. Hilly areas should, however, be left out.

16.6 The Commission has recommended that minimum wages legislation should work progressively towards incorporating measures like social security programmes, provident funds, unemployment and sickness insurance, etc. for the benefit of agricultural labourers.

16.7 The Commission has observed that Indian agriculture has

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to be put on the highroad to development as a robust and dynamic system. It is not merely a technological task. It is a task which implies far-reaching changes in property relations and socio-economic setup of rural India. The central objective is to enable the vast mass of cultivators, whose production potentialities are being wasted today, to combine in full measure their manpower with modern technology so that the whole agrarian economy rises rapidly to ever higher levels.

16.8 The Commission has further observed that the Green Revolution has to reach the threshold of the humble cottage dweller.. This can be done through a process of development in technique linked up with the creation of maximum scope for its utilisation by the great mass of working peasantry. That the Indian Agriculture has a bright future is a matter on which there can be no two opinions. Very few countries in the world have such magnificent natural resources and such manpower. The task is to combine these two in a scientific and planned manner in order to enable maximum production with the largest measure of social justice.

1

REVIEW AND PROGRESS

1 INTRODUCTION

1.1.1 The Royal Commission on Agriculture was appointed in 1926 specially to examine the conditions of agriculture and rural economy in India. Its comprehensive report contained valuable recommendations for the improvement of the agricultural economy. Since then momentous events changed radically the agricultural scene and the national economy. The country was partitioned and attained Independence. The Partition brought in its wake serious imbalances in the country's agricultural resource endowments. After Independence, the Central and the State Governments adopted the objectives of planned economic growth and social development. Also there were new aspirations among the masses, who looked forward not only to a higher standard of life but also for an egalitarian social order.

1.1.2 In the mid-sixties, increasing application of science and technology, supported by infrastructural facilities and the requisite incentives and services set up the stage for the new strategy of agricultural development. In the following years, there was a breakthrough in one or two cereal crops with a promise of similar breakthrough in other cereals and some nonfood crops. While production of foodgrains registered impressive gains, there were shortages in fat and protein production. It, therefore, became necessary to diversify agriculture and to secure an integrated development of crop production, livestock, fisheries and forestry. In this phase of agricultural growth and development, urgent need was felt for policies to deal with emerging problems of disparity among low and high income farmers and between irrigated and rainfed areas and to establish an agrarian system based on equality and justice.

1.1.3 In the context of the agricultural situation indicated above, the Government of India appointed the National Commission on Agriculture on August 29, 1970 with wide ranging terms of reference. The Commission was "to examine comprehensively the current progress of agriculture in India, and to make recommendations for its

improvement and modernisation with a view to promoting the welfare and prosperity of the people." In particular, it was directed to investigate and report on (a) crop production, land and water development; (b) animal products, fisheries and forestry; (c) research, education and training; (d) organisation and supporting measures; (e) employment and manpower; and (f) other aspects like land reforms, special area programmes etc. The Government Resolution relating to the setting up of the Commission and its composition is given in Appendix 1.1.

1.1.4 Besides the statistical and technical data and other material available in the Ministry of Agriculture and Irrigation, Directorate of Economics and Statistics (DES), Indian Council of Agricultural Research (ICAR), Planning Commission and other technical and specialised organisations, the Commission collected a great deal of information on its own. As many as 59 questionnaires were addressed to State Governments, agricultural universities and other educational and research institutes, farmers' organisations, political parties, other agencies and individuals. Twenty seven working groups consisting of specialists in their respective fields were set up to examine in detail and to report on the past performance, problems and potentialities in different sectors of agriculture, relevant matters of policy and technical issues. Some of the working groups set up subgroups and study teams for facilitating their work. Besides, two panels, one of 'Agricultural Administrators' and another of 'Economists' were constituted. The Commission also arranged a few technical studies in depth through specialised institutes and expert organisations to fill in certain gaps in the available information.

1.1.5 With a view to consulting State Governments on important aspects of long-term agricultural policy and development strategy and ascertaining their views, the Commission formulated a series of questions on Policy Issues and forwarded them to State Governments. This was followed up with visits to the States and Union Territories. During these visits, detailed discussions and consultations were held with the Chief Ministers, their Cabinet colleagues, departmental officials and technical experts, not only on the various questions of policy but also on other issues relevant to individual States. Discussions were also held with progressive farmers, representatives of nonofficial organisations, Members of Lok Sabha and Rajya Sabha from the concerned States and Members of State Legislative Assembly and Councils. Consultations with research institutes, agricultural universities and other organisations were arranged through visits by a group of Commission Members, particularly on major issues in the sphere of research, education and extension. Also, the Commission had discussion with

a number of foreign scientists of international repute during the course of the latters' visit to this country.

1.1.6 Before submitting the main Report, the Commission submitted 24 Interim Reports in pursuance of the terms of reference and also at the request of the Union Ministry of Agriculture and Irrigation and the Planning Commission. These Reports concerned issues of immediate importance or which had a bearing on the formulation of the Fifth Plan. A list of these reports is given in Appendix 1.2. The issues discussed in the Interim Reports are mentioned in the main Report, wherever necessary, but are not repeated. Most of the recommendations in the Interim Reports retain their validity, and, therefore, the Interim Reports form important adjuncts to the main Report. A Summary of the important recommendations made in these Interim Reports is provided at the end of this Abridged Report.

1.1.7 The Commission held in all 27 meetings and the Report as a whole was adopted at the last meeting held on December 20, 1975. The Report is unanimous and carries the general consensus of State Governments and concerned Central Ministries and progressive farmers on all major policies and programmes. It comprises 69 Chapters arranged in 15 parts, and deals with problems of agricultural development in 21 States and the Union Territories but does not cover Sikkim. The chapter scheme of the Report is given in Appendix 1.3. The Commission has also submitted Statewise Reports on Rainfall and Cropping Patterns as companion volumes except that of Karnataka State which has been included in the main Report. The data used in the Report mostly relate to 1973-74. The word 'agriculture' has been used in the Report generally in its wide and comprehensive sense to connote crop production together with land and water management, animal husbandry, fishery and forestry.

2 HISTORICAL REVIEW

Royal Commission on Agriculture

1.2.1 The Royal Commission on Agriculture (RCA), which submitted its comprehensive report in 1928, made detailed suggestions and recommendations in various fields like agricultural research, crop production, animal husbandry, forestry, fisheries, cooperation, village development, agricultural finance, communications, marketing, education and public health. Though the Report was accepted as the basis for future development of agriculture, the provincial Governments attempted implementation only by stages as the financial implications

of implementing the recommendations were far beyond the available resources. Nevertheless, immediate action was taken to set up an Imperial Council for Agricultural Research in 1929 for promoting, guiding and coordinating agricultural and veterinary research in India.

1.2.2 A major gap in the recommendations was that pressing problems of land ownership and tenancy were not covered as the subject was excluded from the purview of the RCA. There were no recommendations regarding the special needs of small farmers. Above all, the Provincial Departments of Agriculture remained unduly fettered in regard to financial matters by inelastic rules and regulations and the prevailing system of financing schemes.

Great Economic Depression (1929—33)

1.2.3 Before much progress could be achieved in implementing the recommendations of the RCA, an economic depression of unprecedented magnitude set in. It affected directly India's export market for raw and manufactured jute and indirectly the demand for other Indian exports. The precipitous fall in prices hit the rural population very hard. There was hardly any intervention by the Government either to arrest the fall in prices or to provide support to the economy with the result that agricultural indebtedness nearly doubled between 1929 and 1936.

Constitutional Reforms and After

1.2.4 The Government of India Act, 1935 marked a significant step towards the introduction of responsible government in India. It provided for dyarchy at the Centre and complete autonomy and responsible government in the Provinces. Provincial Governments were to exercise complete control on agriculture, land, water supply, irrigation, forest, fisheries, education, public health etc. However, under the Act, except for a share in income tax, no other elastic source of revenue was allocated to the Provinces. While responsibility for nation building subjects including agriculture was transferred to the Provinces, there was no adequate financial support for making substantial progress in development work. The Act had also provided for the separation of Burma from India, which necessitated considerable economic readjustment, as close links existed between the two economies.

1.2.5 Provincial autonomy came into force in 1937. During the short tenure, the popular Ministries were in office, they sponsored legislative action on social and economic matters bearing on the improvement of agriculture and conditions of the peasantry. Measures

were taken to reduce the burden of indebtedness and regulate money-lending. With a view to ensuring security of tenure and fair rent to tenant cultivators, tenancy Acts were either passed or amended. Some steps were taken for consolidation of holdings, strengthening the cooperative credit structure and creating basic infrastructure for marketing of agricultural produce. With the enactment of the Agricultural Produce (Grading and Marketing) Act, 1936, progress was also made in grading and standardisation of agricultural produce. Among other important developments during this period was the establishment of the Central Jute Committee in 1936 for promoting cultivation and marketing of jute. The Policy of Discriminating Protection, adopted in the case of selected agrobased industries like cotton textiles and sugar manufacturing, helped stimulate cultivation of cotton and sugarcane in the country.

1.2.6 The setting up of a National Planning Committee by the Indian National Congress during this period was a significant augury for the future. However, the Ministries formed by the Indian National Congress remained in office only for about two years. No significant results could be achieved because of their short tenure and the limited power enjoyed by them, particularly over financial resources.

World War II and After

1.2.7 The World War II, which broke out in 1939, dislocated the normal flow of goods, mainly of primary products to foreign countries, which adversely affected the interests of farmers and the agricultural sector as a whole. The Japanese occupation of Burma in 1942 and the consequent stoppage of import of Burma rice completely upset the food strategy of the Government of India. Under these compelling circumstances, the Government had to make a determined effort to increase food production and evolve a viable food policy to meet the prevalent scarcity conditions.

1.2.8 The Grow More Food (GMF) Campaign launched in 1942 marked the beginning of a sustained national endeavour at increasing agricultural production and improving agriculture. Its main objective was to achieve immediate increase in food production through extension of area under cultivation, including diversion of acreage from cash crops like cotton, extension of irrigation and use of inputs like improved seeds, manures and fertilisers. From 1943, in the wake of increasing scarcities and the Bengal Famine, the Government of India began assuming wider responsibilities in regard to food production, a field which for over two decades was the primary concern of Provincial Governments. It began to direct the GMF

Campaign and also sought to bring about greater involvement of Provincial Governments in the drive, by offering them special assistance. The Foodgrains Policy Committee and the Famine Enquiry Commission, appointed during this period, not only endorsed the Campaign but also gave suggestions for improving agriculture.

1.2.9 The foundation for an adequate machinery at the Centre to take care of agricultural development work was laid during this period. In 1942, the Department of Food was created to supervise the difficult food situation. In 1944, as part of the scheme for streamlining the work of GMF Campaign, a number of key posts were created. In 1945, the Department of Education, Health and Lands was trifurcated to form a separate Department of Agriculture. With a view to speeding up land reclamation operations, which was a major element of the GMF Campaign, the Central Tractor Organisation (CTO) was established in 1946. The Directorate of Plant Protection, Quarantine and Storage was also set up in the same year.

1.2.10 A major development of this period was the first ever elaboration in January, 1946, of an all-India policy on agriculture known as 'Statement of Agriculture and Food Policy in India.' According to the Statement, "The All India policy is to promote the welfare of the people and to secure a progressive improvement in their standard of living. This includes the responsibility of providing enough food for all, sufficient in quantity and of requisite quality. For the achievement of these objectives high priority will be given to measures for increasing food resources of the country to the fullest extent and in particular to measures designed to increase the output per acre and to diminish dependence on the vagaries of nature. Their aim will be not only to remove the threat of famine but also to increase the prosperity of the cultivator, raise levels of consumption and create a healthy and vigorous population." The ten objectives of the policy included : increase in production of foodgrains and protective foods; improvement in methods of agricultural production and marketing; stimulating production of raw materials for industry and exports; securing remunerative prices for the producer and fair wages to the agricultural labour; ensuring fair distribution of the food produced and promoting nutritional research and education.

1.2.11 During this period of stress and strain, the Government managed to take some steps to organise research support to agriculture. Four commodity committees were set up between 1944 and 1947 for sugarcane, tobacco, coconut and oil seeds. The Central Rice Research Institute was established at Cuttack in 1946 and two research institutes were set up for the study of problems relating to inland and marine fisheries.

Independence

1.2.12 On August 15, 1947 India became independent. The Departments of Food and Agriculture became Ministries under the charge of a Cabinet Minister. However, the Partition and consequent distribution of irrigation and other resources between India and Pakistan deepened the food crisis in India besides creating new problems in regard to the supply of cotton and jute. The immediate task facing the National Government was to increase domestic production of all agricultural commodities. The GMF Campaign was, therefore, placed on a planned basis from 1947-48. As it was not responding adequately in terms of crop production, a review was undertaken by Lord Boyd Orr at the instance of the Government of India who recommended that the whole campaign should be placed on an emergency footing and bottlenecks of supply and movement of essential materials should be removed. In 1950-51 the GMF Campaign was reoriented to give special attention to compact areas, called 'intensive cultivation areas', which possessed assured water supplies and good soils. Meanwhile, as difficulties of importing cotton and jute from Pakistan increased, the programme was extended to cover these two crops as well and the extended programme called the 'Integrated Production Programme' was launched in June 1950.

1.2.13 In view of the persisting stagnation in crop production the GMF campaign was subjected to a thorough probe in early 1952 by the GMF Enquiry Committee. That Committee was of the view that lack of success in agriculture was mainly due to the inability of the programme to arouse popular enthusiasm and suggested the setting up of a countrywide extension organisation. It also recommended acceleration of minor irrigation programmes, provision of adequate credit and quality seed and development of local manurial resources.

1.2.14 Alongside developmental measures in crop production, agrarian reforms were pushed through in various states. Notable among them during the pre-plan period was the Uttar Pradesh Zamin-dari Abolition and Land Reforms Act of January, 1951. By the end of 1953, all States had abolished the zamindari system. A number of States also enacted legislation to fix fair rent and prevent unfair eviction of tenants.

1.2.15 Towards the close of 1946, the Interim Government appointed an Advisory Planning Board to examine and review the major problems of post-war economic reconstruction. The Board recommended that a permanent Planning Commission should be appointed at the Centre to devote continuous attention to the task of planning and development. The Planning Commission was set up in March

1950 with the Prime Minister as the Chairman. The Commission drew up the draft of the First Five Year Plan by July, 1951 which was finalised in December, 1952.

1.2.16 According to the Constitution, which came into force on January 26, 1950, agriculture, by and large, is a State subject. The Central responsibility in this area had been rather limited confined mainly to regulation and development of inter-State rivers and river valleys fishing beyond territorial waters, institutions of national importance for scientific and technical education and coordination and determination of standards in scientific and technical institutions and those of higher education or research. However, the Third Constitutional Amendment Act, 1954 relating to Entry 33 of the Concurrent List has considerably widened the scope of action by the Centre in agriculture.

Five Year Plans

1.2.17 The major objectives of the First Plan in the field of agriculture were to correct the imbalances caused by the Partition in the supply of foodgrains and commercial crops. Agriculture, including irrigation and power, was accorded the highest priority. A Land policy was also adumbrated seeking to eliminate exploitation and ensuring security of tenure. In the Second Plan, agriculture was accorded a somewhat lower priority. However, towards the close of that plan period, a new approach to agricultural development, based on selectivity of area and concentration of efforts, gained currency, which characterised the programme in the Third Plan. A number of new institutions were set up to extend support to development activities in different fields. Implementation of the Third Plan, however was hindered by unexpected events like border conflicts and droughts. In 1966-67, a new strategy of agricultural development was launched. While most of the programmes adopted under the new strategy were continued in the Fourth Plan, agricultural policy was given a new orientation in favour of weaker sections and backward areas. The role of technology as a major input in agriculture was accorded explicit recognition.

1.2.18 The Community Development (CD) programme, launched in selected districts in October 1952, was assigned a significant role in agricultural development in the First Plan. Apart from the schemes supporting agriculture, it included a number of programmes for improvement of village life as a whole. *Panchayati Raj* institutions were introduced during the Second Plan to provide democratic leadership to the development process in rural India. By 1963-64 almost every village was covered by the CD Programme.

1.2.19 A major limitation of the CD Programme was that scarce resources were dispersed over too wide an area without achieving appreciable increases in production. Therefore, during the closing years of the Second Plan, the Intensive Agricultural District Programme (IADP) was formulated which envisaged concentration of resources and efforts in specially endowed areas to effect a quick breakthrough in production. One district from each State was selected for the purpose. Agricultural support schemes were dovetailed with the main programme of crop production to make the latter more effective. Considerable stress was laid on adoption of package of practices evolved for individual crops. A similar programme, but somewhat diluted, known as Intensive Agricultural Areas Programme (IAAP), was launched in 1964 covering a much larger area. These two programmes marked a significant beginning, because for the first time a fairly large proportion of cropped area in the country possessing adequate production potential was brought under intensive efforts.

1.2.20 The intensive area approach acquired a new potency with the emergence of exotic high yielding varieties of cereal crops and contemporaneous technological improvements. These were brought together under the High Yielding Varieties Programme (HYVP), which constituted the main thrust of the new strategy. With a view to taking advantage of the short duration characteristic of the new strains and the limited irrigation facilities available in the country for achieving maximum production per unit area, a new programme envisaging multiple cropping (MCP) was dovetailed with the HYVP in the following year. While continuing this strategy in the Fourth Plan, the orientation in favour of the weaker sections was sought to be achieved through special programmes for small and marginal farmers, agricultural labourers, drought prone areas, dry farming and the like.

1.2.21 From the days of the GMF Campaign, the Government of India has been assisting the Provinces financially in the implementation of agricultural schemes. The policy of Central assistance acquired a new significance in the five year plans. Not only the magnitude of resources allocated increased, but there was a new approach both in regard to the priority of projects assisted and the pattern and procedure in the sanction and disbursement of assistance. The schemewise pattern of Central assistance followed in the First Plan was found dilatory and hence aid was made available under broad Heads of development. The Central assistance made under the major heads of agriculture was not allowed to be diverted to any other head of development from 1963-64. In order to provide adequate outlays

for certain agricultural programmes like demonstration, surveys and research, a new category of Centrally sponsored scheme was introduced during the Second Plan. The coverage and allocation under these schemes were increased in the subsequent plans. The procedure for release of Central assistance to State plan schemes was further simplified during the Fourth Plan.

1.2.22 Soon after the World War II, work on a few multipurpose projects, like Bhakra-Nangal, Damodar Valley and Hirakud, was taken up for augmenting irrigation as also power. Many more such schemes with an aggregate irrigation potential of about 15 million hectares (Mha) were taken up for implementation in the first two plans. Beginning from the Third Plan, greater emphasis was placed on completion of projects under construction and utilisation of the potential already created. Special attention was given to the completion of complementary works like field channels. A Centrally sponsored schemes for ayacut development was formulated during the mid-sixties to facilitate fuller and more efficient utilisation of irrigation potential in command areas.

1.2.23 In April, 1969, the Government of India appointed the Irrigation Commission to go into the question of future irrigation development in the country. The Commission made a number of recommendations bearing on irrigation development, irrigation policy and irrigation administration in its report published in 1972.

1.2.24 The development of minor irrigation, which received special attention in the early forties under the GMF Campaign, was given a compact area approach in the First Plan. The Exploratory Tubewells Organisation (ETO) was set up in 1954 to intensify efforts at deep strata exploration. Greater allocation was made to the programme in the subsequent plan, particularly in view of its short gestation and immediate contribution to production. A Ground Water Survey and Investigation Programme was initiated in 1966-67 to provide assistance to States in this field. Special efforts were also made to organise institutional credit for development of minor irrigation and to link up area plans for minor irrigation development with programmes for rural electrification.

1.2.25 Early in the seventies the Government of India took measures to streamline and strengthen the administrative set up for ground water development. The ETO was reorganised into the Central Ground Water Board in 1970. From August, 1972, the Ground Water Wing of the Geological Survey was also integrated with the Board. The Rural Electrification Corporation was set up in July, 1969 for assisting State Electricity Boards and rural electricity cooperatives with loans.

1.2.26 As for improved seeds, the first two plans followed a policy of decentralisation of production and distribution. Seed farms of 10 hectares size were sought to be set up in every block for producing quality seeds. The seed problem acquired a new dimension after the arrival of hybrids and exotic strains. The Government, therefore, set up the National Seeds Corporation (NSC) in 1963 to undertake production, stocking and supply of foundation seeds. The government also passed the seeds Act, 1966 to ensure that seeds produced in the country were of requisite quality. The seed programme was further streamlined during the Fourth Plan. This has been discussed in details in the later chapters.

1.2.27 Chemical fertiliser was recognised as an important farm input and attention was directed towards its production and promotion. Fertiliser plants were set up to meet a sizable part of domestic requirements. The promotion programmes, however, encountered difficulties due to inadequate supplies and lack of credit support. During the Third Plan, besides fixing specific targets for different types of fertilisers, a number of steps were taken to promote their application which included reduction and off season rebate in prices, subsidy on road transport etc. However, actual consumption of fertilisers did not go beyond 50 per cent of the targeted levels, mainly because of the shortfall in domestic production and the inability to arrange for imports. The Government announced a new fertiliser policy in December, 1965, allowing the private sector to set up new plants with foreign collaboration. To ensure equitable distribution of available supplies, the Government reserved the right to lift a percentage of factory production at negotiated prices. In view of the lack of tempo in the offtake of fertilisers, even after the launching of HYVP, measures were taken to stimulate demand and arrange speedy supply of requirements. These included extension of soil testing facilities, increased use of soil amendments, intensification of extension and sales promotion, opening of more retail points and enhanced provision for distribution credit. Side by side, stress was also laid on increased use of cattle dung, green manure, oil cake, bone and fish meal, compost etc.

1.2.28 In plant protection, there was a gradual shift from curative to prophylactic approach over the years. During the early years it was locust control that received more attention; but in subsequent years, preventive measures came to be adopted on a much larger scale. The later plans envisaged more intensive measures of seed treatment, weed control and post sowing prophylactic treatment. Arrangements for aerial spraying operations were also strengthened by setting up a separate Directorate of Agricultural Aviation.

1.2.29 The main line of action in the area of agricultural implements was to select a few efficient and important implements and popularise them. Not only demonstration and propaganda were organised but subsidies were also extended to facilitate their acquisition by farmers. A Board of Agricultural Machinery and Implements was set up to take care of their manufacture and popularisation. During the mid-sixties, agro-industries corporations were set up in States for attending to the work of procuring and distributing farm machinery including tractors and providing servicing and repair facilities and custom service. The Fourth Plan envisaged intensification of research in agricultural engineering and improvement in arrangements for fabrication and distribution of implements. Programmes for training in the use of machinery as well as testing were also given due attention.

1.2.30 Measures for land resource improvement, adopted under the plans, related mainly to soil conservation, consolidation of holdings and cooperative farming. Since the Second Plan, a sustained policy for soil conservation and dry farming had been pursued. Besides initiating an all India soil conservation and land use survey, 45 dry farming projects, each covering 400 ha, were undertaken for popularising dry farming techniques. Special soil conservation measures were initiated in the catchment of river valley projects. Demonstration on dry farming methods was further strengthened in the Fourth Plan. Emphasis was also laid on soil conservation measures in the Integrated Dry Land Agricultural Development Programme, the Drought Prone Areas Programme and the Crash Programme for Rural Employment. Besides, the Government also pursued a policy of firm support to consolidation of holdings, providing legislative backing to measures, wherever necessary. Cooperative farming ventures were also promoted and assisted.

1.2.31 According to the Rural Credit Survey Committee (RCSC) 1951, cooperatives accounted for only 3.1 per cent of the total agricultural credit, bulk of the credit being advanced by individuals including moneylenders. The Committee made a number of recommendations to augment cooperative credit and strengthen the cooperative movement. The emergence of the State Bank of India, the National Cooperative Development and Warehousing Board and the Central and State Warehousing Corporations and the establishment of the National Agricultural Credit (Long Term Operations) Fund and the National Agricultural Credit (Stabilization) Fund with the Reserve Bank of India (RBI) in the fifties were based on the recommendations of that Committee. During the Second Plan, efforts were made to advance loans to cultivators on the basis of

production programmes and anticipated outturn instead of land security. The tieup between credit societies and marketing societies was considered particularly important as it facilitated smooth and immediate recovery of dues.

1.2.32 By 1961-62, the share of cooperatives in total agricultural credit had improved to 15.5 per cent. The Third Plan envisaged even greater involvement of cooperatives in providing credit for agriculture. Efforts were, therefore, directed to strengthen and revitalise the cooperative structure at the grass root level, mainly by increasing membership and share capital of existing societies, mobilising deposits and organising new societies, wherever needed. Special promotional measures were taken in areas, such as in the eastern States, where the movement was rather weak. As the progress of linking credit with marketing was not quite satisfactory, a special programme was launched in the IADP districts in 1964-65, attempting to link credit with production plans and to simplify loaning procedures.

1.2.33 In July 1963, the Agricultural Refinance Corporation, now renamed as Agricultural Refinance and Development Corporation (ARDC), was set up with a large capital to facilitate greater flow of long term loan to agriculture. With a view to promoting short term cooperative credit, an Agricultural Credit Stabilisation Fund was established with apex cooperative banks and special credit limits were provided to cooperatives by the RBI to meet the needs of the HYVP. The purpose of the Fund was to afford relief to cultivators, who were unable to repay their loans due to crop failure.

1.2.34 To further improve the flow of agricultural credit to the weaker sections, like small farmers and marginal farmers, the Government set up Small and Marginal Farmers Development Agencies in selected districts. The recommendation to this effect was made by All India Rural Credit Review Committee. That Committee had also made a number of suggestions to strengthen the cooperative credit structure in the country. In April, 1968, a consortium of commercial banks set up the Agricultural Finance Corporation (AFC) with the objective of helping commercial banks to participate in the development of agriculture. Their involvement became deeper following the nationalisation of leading commercial banks on July, 19, 1969.

1.2.35 In the integrated scheme of rural credit recommended by the RCSC, marketing was an important element. Since the Second Plan, organisation of marketing societies received greater attention. The National Agricultural Cooperative Marketing Federation was set up during this period to promote inter-State trade, coordinate activities of apex marketing societies and provide marketing intelligence

to them. During the Third Plan, a larger number of marketing societies were set up so as to cover all important secondary markets. For meeting possible losses in purchase operations, Government introduced a policy of special contribution to Price Fluctuation Fund. The policy followed in the Fourth Plan had been to strengthen the existing structure at the primary level and to make the apex federations at the State and national levels more efficient. Marketing societies made significant progress in inter-State and export trade with the help of National Agricultural Cooperative Marketing Federation. The Food Corporation of India, the Cotton Corporation of India (1970) and the Jute Corporation of India (1971) envisaged a special role for cooperative marketing societies.

1.2.36 The Government had been following a policy of price support to agricultural produce since June, 1957. Based on the recommendations of the Foodgrains Prices Committee, 1964, the Agricultural Prices Commission was set up to advise the Government on price policy in respect of all agricultural commodities. That Committee had also laid down guidelines for fixing an incentive-oriented minimum or support prices for crops.

1.2.37 In the field of agricultural statistics and agro-intelligence, establishment of Agroeconomic Research Centres (AERC) and the organisation of farm management studies were important developments. Besides, studying rural change, the AERC provided expert opinion and first hand information based on field investigations on current agricultural problems of national importance. The farm management studies undertaken in typical regions yielded valuable data on important aspects of farm business including cost of production. The improvement of agricultural statistics and making available upto date agricultural intelligence have been receiving continuing attention in the Directorate of Economics and Statistics and other organisations of the Central Government.

1.2.38 The land policy set out in the First Plan recognised that the pattern of ownership and operation of land was of great importance in planning for bringing economic and social change. The principal programmes of land and tenancy reforms envisaged in the First Plan included abolition of intermediary rights, curbs on future acquisition of land and on resumption for personal cultivation, provision of security of tenure to tenant cultivators and fixation of fair rent. The Second Plan suggested a ceiling on land holdings. While significant progress was achieved in abolishing intermediary tenures, progress was rather limited in the other fields. During the Third Plan, State Governments were mainly preoccupied with the follow up of various legislative measures already enacted. Even so,

progress continued to be slow due to snags in legislation and several other obstructions like nonavailability of upto date land records.

1.2.39. In 1963, the National Development Council constituted a Committee to review progress of land reform measures in different States and proposes measures for accelerating the implementation of land reform legislation. A Central Land Reforms Committee was set up in 1970 to undertake a continuous study of land reform problems and to advise and assist the States in determining and carrying out programmes of land reforms. Considerable attention was given to the question of land ceilings during the Fourth Plan period. A set of national guidelines on agricultural land ceilings were formulated in 1972 with a view to bringing about a measure of uniformity in ceiling legislation in different States.

1.2.40 The policy in the field of animal husbandry under the five year plans was to improve the quality and productivity of livestock through improved breeding, adequate feeding and control of diseases. The initiation of the Key Village Scheme in August, 1952 was the first systematic effort made in this direction. Improvement of marketing arrangements, development of village grasslands and promotion of cultivation and conservation of fodder crops were also attempted in key village areas. During 1964-65, an extended version of this scheme, known as Intensive Cattle Development Project was launched in the milkshed areas of major dairy plants. It envisaged the provision of a package of improved practices to cattle owners to effect a breakthrough in milk production, the objective being to ensure an increase in production of milk and a steady flow of milk to the dairy plants. A new breeding policy was also introduced which laid emphasis on crossbreeding. The approach to livestock development in the Fourth Plan was based on three major considerations, viz. increasing domestic production, improving nutritional levels and diversification of the economy of small and marginal farmers and agricultural labourers. The cattle breeding policy was modified to lay more stress on crossbreeding with exotic breeds and improving milking qualities of recognised breeds. The ICAR launched two all-India coordinated research projects, one on cattle breeding and another on buffalo breeding. A national programme of mass vaccination of cattle and buffaloes against rinderpest was undertaken with good results. The development of sheep for wool, poultry and piggery also received attention. Continuous efforts were made during the plans to control animal diseases.

1.2.41 Dairy development programmes in the successive plans aimed at organising production, processing and distribution of milk to cater to the needs of expanding urban areas and to provide subsi-

diary occupation in the rural areas. Schemes for dairying and milk supply were initiated in the State sector during the First Plan period itself. During the Second Plan, efforts were mainly directed to establish colonies of milch cattle in metropolitan cities. The emphasis shifted in the Third Plan to milk production in rural areas and a link up of rural dairies with milk plants in urban centres. Collection of milk from villages and its processing and distribution were sought to be organised, as far as possible, on cooperative lines. The Operation Flood Project, started in 1970-71, was the biggest milk drive launched so far in any country. The major objectives of the scheme were to raise the capacity and throughput of dairy plants serving major cities, capture the bulk of urban market for these units and shift cattle from cities to rural areas.

1.2.42 Under the First Plan, a number of measures were taken for the development of inland and marine fisheries. These included improvements to existing methods of fishing, introduction of scientific fish farming techniques and development of fish culture in large unutilised areas. Problems of marketing and storage too received attention. In 1952-53, a project for marine fishery development was launched in collaboration with the Government of Norway. Arrangements were also made for providing training facilities to different types of personnel. The Second Plan gave greater attention to the development of marine fisheries. Boat building yards were established at selected centres and a large number of boats were mechanised. The Third Plan laid emphasis on mechanisation of fishing boats, provisions of refrigerated rail and road transport, and arrangements for research and training facilities. The development of export potential of fish and fish products was given priority. Some States set up fisheries corporations to promote deep-sea fishing and export of fish products and to develop inland fisheries. A Central Fisheries Corporation was established in 1966 to promote regulated marketing of fish. The Fourth Plan sought to further develop the export potential, increase fish production and also improve the economy of fishermen. Greater importance was attached to the development of marine fisheries, particularly deep sea fishing. Though the Indo-Norwegian Project came to a close in March, 1972, the scheme was continued in view of its importance and renamed as 'Integrated Fisheries Project'.

1.2.43 The forest policy announced in 1952 envisaged measures for evolving a system of balanced and complementary land use, checking denudation in mountainous regions, preventing soil erosion, particularly along river banks, and stabilising sand dunes in desert areas. It also spelt out measures for improving the outturn of timber

and other forest produce, augmenting grazing and fodder resources and establishing tree plantations, wherever possible. A Central Board of Forestry was constituted earlier in June, 1950 as the supreme advisory body to formulate, implement and review the forest policy. The focus of the first two plans was mainly on rehabilitation of degraded forests. Large areas of forest land under private ownership and management were also brought under State control. There was a shift in forest development policy in the Third Plan from conservation and biological management towards increasing production through man-made forests. Plantation of quick growing trees and other species of industrial and commercial importance were sought to be raised on a large scale. A pre-investment survey of forest resources and industries was launched during this period to facilitate the formulation of a long-term programme for forestry development. In August, 1965, a Central Forestry Commission was set up; among other things, it was required to study the implementation of the National Forest Policy and conduct market studies on timber and other forest produce and their utilisation.

1.2.44 The Ministries of Agriculture and Food were combined in January, 1951 to form the Ministry of Food and Agriculture. In the wake of the Community Development Programme, the Directorate of Extension was set up in May, 1955 and a separate Ministry of Community Development and Co-operation came into being in September, 1956. The emergence of the new Ministry, however, led to some duplication of efforts and lack of coordination. With a view to ensuring integrated approach in the formulation of agricultural policies and programmes, an Agricultural Production Board was constituted in November, 1963 at the Centre. The States also set up similar bodies at the Cabinet and Secretariat levels to coordinate and streamline the activities of various departments. A number of high level posts were created in the Department of Agriculture for providing guidance and support to programmes under implementation.

1.2.45 The need for an integrated approach to agricultural production programmes, closer coordination among the departments concerned and better streamlining of functions and operations within the departments became increasingly manifest when the new strategy of agricultural development was launched. A number of steps were initiated beginning from 1965 to reorganise the Ministry, particularly the Department of Agriculture. The Ministry of Community Development and Cooperation was merged with the Ministry of Food and Agriculture in 1966 to form the Ministry of Agriculture, Community Development and Cooperation and a series of work adjustments were effected within the Department of Agriculture. The most significant outcome of the reorganisation was that for the first time, the control

of the Departments of Agriculture, Community Development and Co-operation came to be vested in one Secretary. In October, 1974, the subject of irrigation was transferred from the Ministry of Irrigation and Power to the Ministry of Agriculture and the latter was renamed Ministry of Agriculture and Irrigation. Earlier in December, 1973, a new Department of Agricultural Research and Education was organised in the Ministry with a view to providing necessary governmental linkage for the ICAR in the matter of agricultural research and education.

1.2.46 After the devolution of powers under the Constitutional Reforms of 1919 and 1935, the onus of developing provincial Departments of Agriculture passed to Provincial Governments. There was, however, no significant expansion in staff or activities till early forties, mainly because of budgetary constraints. The GMF campaign launched in 1942-43 marked the turning point. Following the strengthening of the Central departments, steps were taken to strengthen Provincial departments and district level administration. Even so, the State Agricultural Departments at the time of Independence were considered to be comparatively unimportant. The picture changed rapidly, following the introduction of Community Development Programme and National Extension Service. Two committees appointed in 1957 viz. the Agricultural Personnel Committee and the Agricultural Administration Committee recommended strengthening of State Departments of Agriculture, streamlining of their activities in the context of agricultural planning and improvement in terms and conditions of employment in agricultural departments. The adoption of intensive agricultural programmes like IADP and the IAAP marked the next phase in development of State Departments. However, the expansion of State Agricultural departments was not according to any set design or pattern which led to unbalanced growth among departments. With the steady increase in departmental activities, other problems also came to the fore like dual control on agricultural field staff, diffusion of authority and lack of coordination. To get over these problems and secure effective implementation of programmes, the Working Group on Inter-Departmental and Institutional Coordination for Agricultural Production recommended the establishment of an integrated Department of Agriculture and Rural Development with a common Secretary-cum-Commissioner and the setting up of coordination committees at the headquarter and field levels.

1.2.47 The trend in agricultural research in the early years was to organise efforts cropwise and institutionwise, without achieving adequate coordination. This trend was reversed by policies initiated during the Plans; instead a comprehensive regional approach was

adopted. The trend got further support with the emergence of agricultural universities in the sixties.

1.2.48 The ICAR was originally set up as a registered society to promote, guide and coordinate agricultural research. These objectives remained largely unattained, because of the multiplicity of institutions involved and lack of administrative and financial control and coordination. The ICAR was, therefore, reorganised into an autonomous body to ensure coordination, direction and promotion of agricultural research and education in the country. Practically, all Central research institutes under the control of the Departments of Agriculture and Food were transferred to the Council and were made constituent units. All commodity committees were abolished and research institutes under their control were transferred to the Council. The scope of the all India coordinated research projects was considerably widened during the Fourth Plan so as to cover not only all important food and nonfood crops but also major problems confronting agriculture.

1.2.49 Though at the time of Independence, there were 17 agricultural colleges, the quality of agricultural education remained generally neglected. The University Education Commission (1949) recommended the setting up of the rural universities. Education in these universities was to be tempered with research and enriched from field experience. The first agricultural university came up at Pantnagar in Uttar Pradesh in 1960, which was followed by similar universities in other States. As far agricultural education at the school level, the basic school system tried in some States did not prove very successful. The Education Commission, 1964-66, therefore, disfavoured specialisation in agriculture at the high school level and instead suggested some orientation to agriculture as part of education in schools.

1.2.50 Under the CD programme, special importance was attached to demonstrations as part of agricultural extension. However, these were not very successful mainly because of the poor level of expertise of the organisers, the inability to adopt a package approach to crop production and the failure to follow recommended practices. Determined efforts to improve the quality and content of demonstrations were made under the IADP. More sophistication was brought into the programme with the launching of national demonstrations in 1965. Emphasis in these demonstrations was on maximising production per unit area, per unit time, by following multiple cropping and using highyielding cereal crops in conjunction with improved soil and water management practices. These demonstrations were gradually extended to cover cereal and noncereal crops. A programme of functional literacy was started in 1967-68. Farm broadcasts, televi-

sion programme on a limited scale, discussion groups and audiovisual aids were also used for educating farmers. Agricultural information units at the Centre and in the States disseminated information of interest to the farming community.

1.2.51 A number of countries and organisations have been providing financial aid and technical assistance to programmes of agricultural development. Although a good part of financial aid from some countries was in the form of commodity assistance which often took the form of concessional imports, technical assistance was an integral part of aid received from most of the countries and organisations. India had also been getting substantial economic aid from the World Bank. An important feature of the World Bank assistance was that a good number of loans extended through its affiliate, the International Development Association, were soft and long term. Among non-official organisations, which provided technical assistance to agricultural development, the Rockefeller Foundation and the Ford Foundation deserve special mention.

3 PROGRESS OF AGRICULTURAL DEVELOPMENT

1.3.1 This section deals with progress of agriculture in two phases, first, prior to the advent of planning i.e. from 1931 to 1951 and second, during the plan period i.e. from 1951 to 1974. Assessment of progress during the early phase relates to undivided India. Trends during the decade 1964-65 to 1973-74 are discussed separately to focus on certain important aspects which have emerged in crop production under the 'new strategy'. A synoptic view of current agriculture situation is also given.

Trends in Population, Land Use and Consumption of Foodgrains

1.3.2 During the first two decades of the century, population of the Indian Union increased rather slowly from 238.3 million to 251.2 million. In the following three decades from 1921, population recorded a moderate increase of 11 to 14 per cent per decade to reach the level of 361 million in 1951. The order of increase registered thereafter was rather sharp—21.6 per cent during 1951-61 and 24.8 per cent during 1961-71—taking the population to 547.9 million in 1971, which was nearly twice as much as in 1931. The urban population grew much faster during the last 40 years from 33.5 million to 109.1 million i.e. by 226 per cent compared to rural population which increased by 79 per cent.

1.3.3 The total geographical area of India is 328 Mha. Land

utilisation statistics are available for 305.6 Mha or 93.2 per cent of the total area in 1971-72. The extent of arable land (net area sown plus current and other fallow lands) was 160.6 Mha or 52.6 per cent of the reporting area. An area 65.8 Mha or 21.5 per cent of the total was under forests. Lands put to non-agricultural uses and those which were barren and uncultivable were put at 16.4 Mha (5.4 per cent) and 29.3 Mha (9.6 per cent) respectively. Permanent pastures and other grazing lands covered 13.1 Mha (4.3 per cent), land under miscellaneous tree crops and groves 4.4 Mha (1.4 per cent) and cultivable waste lands another 15.9 Mha (5.2 per cent).

1.3.4 In the first few years of planning, net area sown in the country increased due to largescale land reclamation and then gradually stabilised. The increase during the First Plan period was from 119 Mha to 129 Mha and after remaining low for nearly 15 years it reached 139 Mha during 1971-72. States reporting a higher order of increase in net area sown were Rajasthan, Gujarat, Kerala, Madhya Pradesh and Tamil Nadu where the increase recorded was in the range of 16 to 45 per cent during the first three plan periods.

1.3.5 The net area irrigated in the country went up from 17.1 Mha during the quinquennium ending 1934-35 to 19.4 Mha during the quinquennium ending 1949-59 i.e. by 13.5 per cent. By 1971-72, net area irrigated moved up to 31.6 Mha as compared to 24.7 Mha in 1960-61 and 20.9 Mha in 1950-51 showing an overall increase of 51.2 per cent during the entire period. This was brought about mainly be expansion in canal irrigation and irrigation from wells. The proportions of area receiving irrigation from these two sources during 1971-72 were 37.6 per cent and 38.1 per cent respectively as against 34.3 per cent and 28.7 per cent in 1950-51. Well irrigation increased faster than canal irrigation during the period. The spread of irrigation was, however, uneven. In Punjab, Haryana and Tamil Nadu net area irrigated in 1971-72 was as high as 73 per cent, 44 per cent and 43 per cent respectively of net sown area; in Madhya Pradesh, Maharashtra, Karnataka, Gujarat and Rajasthan, this proportion varied between 8 and 14 per cent.

1.3.6 Cropwise, 80 per cent of the gross irrigated area was under foodgrains crop. Among foodgrains, area irrigated under wheat increased three fold between 1950-51 and 1971-72 whereas that under rice rose hardly by 50 per cent. In the case of commercial crops, significant increase in irrigation was observed in respect of cotton.

1.3.7 Taking into consideration the entire geographical area in the country, the present per capita availability of land comes to only 0.6 ha. The per capita availability of net sown area was only 0.25 ha in 1972. It was 0.35 ha in 1931 and 0.33 ha in 1951. Land

availability in India is among the lowest in the world.

1.3.8 The per capita production of foodgrain in the Indian Union declined steadily during the forties but improved thereafter. The average annual figures for the quinquennia ending 1941, 1951 and 1965 were 198 Kg, 166 Kg. and 178 Kg. respectively. A high order of variation was observed during recent years from 1966 to 1974, mainly as a result of natural calamities resulting in lower production on the one hand, and favourable weather conditions under technological advances in crop production, raising output to higher levels, on the other.

1.3.9 The trends in per capita availability of foodgrains for consumption broadly reflected the trend in population and foodgrains production. No significant reduction was observed during 1901 to 1926 in undivided India when annual per capita availability of foodgrains remained at about 200Kg. There was, however a decline in availability in the next 20 years when population showed a steady increased but production remained stagnant. Annual availability was at the lowest level of 152 Kg during the years of the Second World War. Confining the analysis to the India Union there was some improvement in foodgrains availability in the following years. But due to the sharp increase in population, average annual per capita availability during the quinquennium ending 1970-71 was only 162 Kg. However, if various items that constituted the food basket like cereals, pulses, potatoes, eggs, meat, fish, milk etc. were taken into account in terms of calories, there had been some improvement in per capita food availability during the Plan period.

Crop Production During Pre-Plan Period

1.3.10 In undivided India between 1900 and 1930, area under foodgrains increased by 7 per cent that under non-foodgrains by 35 per cent and all crops together by about 12 per cent. The relative share of foodgrains in gross cropped area showed a decline. Production of foodgrain was rather stagnant during the 30 year period while that of non-foodgrains showed a steadily rising trend and moved up by 39 per cent. Among foodgrains, production of rice and coarse cereals remained stagnant; the former even showed a decline during the latter half of the period. Wheat and gram were the only two crops in this group which recorded a rising trend in production. The record of commercial crops was encouraging. Cotton, jute, sugarcane and tea recorded large increases in production. The annual average compound rate of growth of production during the period 1901 to 1930 worked out to (-)0.02 per cent in the case of foodgrains, 1.25 per cent for non-foodgrains and 0.31 per cent for all crops. Thus, while

production of foodgrains during this period remained stagnant, there were definite signs of growth of commercial crops.

1.3.11 Yield estimates during the period were based on traditional method involving normal yield and condition factors, both of which were subjective in character. For the country as a whole, productivity showed a declining trend in case of foodgrains and some increase in case of commercial crops. The improvement in yield rates coupled with increase in area led to the higher production of commercial crops.

1.3.12 Complete lack of improvement in technology and investment characterised farming during this period. Irrigation, however, helped in arresting crop failures and making farming more intensive in some areas. It also helped in protecting soil fertility by diversifying the cropping pattern.

1.3.13 During the 17 year period from 1931 to 1947, agricultural production remained stagnant with a compound rate of growth of only 0.03 per cent per annum. While foodgrains production recorded a fall of 0.02 per cent, non-foodgrains showed a growth of 0.44 per cent per annum. The production of rice, jowar, maize and gram remained almost stagnant throughout the period, while that of wheat and bajra showed some improvement up to the quinquennium ending 1944-45 and then a fall. Among commercial crops, performance of oilseeds was rather poor. Production of sugarcane and tea registered a continuous upward trend. Fibres showed impressive increase during the quinquennium ending 1939-40. However, during the next five years under the impact of the GMF campaign, there was a fall in production due to diversion of area to foodgrains. While production of cotton continued to decline in the next two years, that of jute rallied to the level reached during the quinquennium ending 1939-40. While irrigation continued to be main strength of agriculture, other technological factors like improved seeds and agricultural education also began making some impact during 1931-47. Significant increase in area under improved strains was reported in the case of wheat among foodgrains and sugarcane, cotton and jute among cash crops. Though chemical fertiliser used to be imported, its use was confined to cash crops, particularly plantation crops. Agricultural implements in vogue remained largely conventional and crops grown and the manner of farming conformed to tradition. Some progress though not very encouraging was made in agricultural education in terms of number of colleges opened and students. The difficulties on the food front were greatly aggravated by the Partition in 1947, which resulted in the case of Indian Union, in uneven distribution of agricultural resources and shortage of industrial raw materials like cotton and jute. The National Government gave high priority to the develop-

ment of agriculture and took a number of steps for increasing production.

1.3.14 The land use statistics, adjusted for changes in methods of collection and estimation, showed an increase of only about a million hectares in net area sown and a marginal increase in gross cropped area during 1947-50. The share of foodgrains and non-foodgrains in the total cropped area remained constant at 77.4 per cent and 22.6 per cent respectively. Among foodgrains, increase in area was reported under rice, jowar, bajra, wheat and gram while there was no change in the area under maize and barley. In the case of commercial crops, cotton and jute recorded some gains while sugarcane and groundnut recorded a fall. On the production front only foodgrains showed any increase, marginal though, whereas non-foodgrains recorded a drop. Among foodgrains, production of rice, bajra and wheat recorded some increase and among non-foodgrains, production of cotton and jute improved significantly while that of oilseeds and sugarcane registered a decline. For achieving increases in agricultural production, greater emphasis was placed on extension of irrigation facilities particularly through development of minor irrigation under the GMF campaign.

Crop Production During Five Year Plans

1.3.15 Beginning from 1951, sustained efforts were made under the five year plans to increase production of foodgrains and raw materials and improve agriculture in general. Agriculture received priority in the matter of allocation of funds in all the plans. Its share in the total public sector expenditure increased from 21 per cent in the Second Plan to 24 per cent in the Fourth Plan. In absolute terms, from the First Plan to the Fourth Plan, the increase was from Rs. 724 crores to Rs. 3948 crores or nearly 5½ times. There was also significant increase in private sector investment in agriculture during the period, the order of such investment during the Fourth Plan period was estimated at Rs. 1600 crores. For assessing the performance of agriculture under the plans, the period is divided into two time-spans, namely the years 1950-51 to 1966-67 and the years 1967-68 to 1973-74. During the earlier period, efforts at increasing agricultural production proceeded more or less on traditional lines with emphasis on irrigation and traditional inputs like improved seeds and fertilisers. During the later period, the new strategy of agricultural development, based on scientific advances in farm technology, was adopted in order to achieve a breakthrough.

1.3.16 The compound annual rate of growth of agricultural production at all India level during the period 1949-50 to 1973-74 was

2.7 per cent to which the contribution of yield was slightly more than that of area. If the period up to 1964-65 only was considered, the growth rate was higher at 3.2 per cent per annum to which yield and area contributed in equal measure. If the period 1960-61 to 1973-74 is considered, there was considerable deceleration in growth; the growth rate of overall agricultural production was only to 2.1 per cent per annum. During this period, expansion in cropped area slowed down considerably and the contribution of productivity to overall growth increased significantly. If the Plan periods were considered separately, the highest rate of growth of 4.1 per cent per annum was observed during the First Plan; during the Second and Third Plan periods, agricultural production expanded at about 3 per cent per annum and at a much lower rate of 2.2 per cent during the Fourth Plan period.

Factors of Change in Crop Output (1950—74)

1.3.17 The production of foodgrains during the period 1950-51 to 1973-74, increased at the compound rate of 2.46 per cent per annum. This increase, however, was not accompanied by any stability in production. During the first two plan periods, the rate of growth recorded was comparatively higher and production more stable. The position was different during the later period i.e. 1960-61 to 1973-74; production of foodgrains showed not only a lower rate of growth but also greater instability.

1.3.18 Under the stimulus of State schemes of land reclamation and facilities offered to cultivators for bringing new lands under cultivation, net area sown recorded a moderate increase in the first few years of planning and remained rather steady thereafter. During the First Plant period, net area sown increased by 7.2 per cent; corresponding increases during the Second and Third Plan periods were 3.2 per cent and 3.6 per cent respectively. However, the gross cropped area recorded a higher rate of increase, being 15.1 per cent, 5.1 per cent and 4.1 per cent during the First, Second and Third Plan period respectively.

1.3.19 The relative share of foodgrains in gross cropped area declined during the period under review from 76.7 per cent (1950-51) to 73.7 per cent (1966-67). In the pre-independence period this share was about 80 per cent. Significant changes were also observed in the cropping mix in different areas. The index number of cropping pattern compiled for the period showed that there had been a shift towards high value crops, like wheat, groundnut and cotton, in preference to low value crops like millets. Despite frequent fluctuations and serious setbacks in certain years, there had been sizable

improvement in agricultural production during the period. The all India index of agricultural production triennium ending 1961-62=100) which stood at 68.9 in 1950-51 recorded a steady increase in the first 10 years touching 84.4 in 1955-56 and 102.7 in 1960-61. The next 7 years, with the exception of 1964-65, were unfavourable due to bad weather. In 1964-65 agricultural production went-up, the index touching the high level of 115 points. The following two years indicated the extent to which bad weather could pull down crop production. In fact, the droughts of 1965-66 and 1966-67 were quite unusual in intensity and spread and, as a result, the index of production dropped to 96 points. If these two unusual years could be ignored, the underlying trend in production was that of steady increase. During the period 1949-50 to 1964-65 the annual rate of growth in production was 2.98 per cent for foodgrains and 3.61 per cent for non-foodgrains. The compound growth rates of production in respect of individual crops during this period were 3.97 per cent for wheat, 3.79 per cent for maize and 3.37 per cent for rice among foodgrains and 8.48 per cent for coffee, 4.59 per cent for sugarcane, 4.44 per cent for cotton and 4.18 per cent for groundnut.

1.3.20 The compound rate of growth of overall agricultural productivity during 1949-50 to 1964-65 was 1.60 per cent per annum against 1.61 per cent in the case of foodgrains and 1.06 per cent for non-foodgrains. Among foodgrains, rice had the highest growth rate (2.09 per cent) followed by jowar (1.58 per cent) and wheat (1.24 per cent). Pulses, however, recorded a negative growth rate. Among commercial crops, coffee recorded the highest growth rate (6.17 per cent); cotton; sugarcane and tea also showed improvement (the rate of growth being 1.97 per cent, 1.29 per cent and 1.48 per cent respectively). In the case of oilseeds, groundnut showed a very low rate of growth of 0.36 per cent whereas the performance of oilseeds as a group was somewhat better.

1.3.21 During the period 1967-74, there was some increase in net and gross cropped area, the latter being relatively more. Compared to the earlier period, there was greater increase in area under foodgrains, including some diversion from non-foodgrain crops. Area under wheat recorded the highest increase among foodgrains followed by maize, bajra and rice; jowar, however, suffered a set back. In the case of pulses, despite a decline in area sown to gram and tur, the aggregate area remained more or less unchanged. The downward trend in respect of gram could be attributed to diversion of area to wheat in the northern States after the introduction of high yielding varieties. While area under oil seeds as a group showed a fluctuating trend, there was a significant decline in the case of groundnut and sesamum. Area under cotton and jute too recorded a drop. Crops like

sugarcane tea, coffee, rubber and tobacco reported appreciable increase in area during this period.

1.3.22 The new strategy made a significant impact on agricultural production. The index of agricultural production (triennium 1961-62=100) touched a record level of 131.6 in 1973-74 compared with the level of 115 attained in 1964-65 and 96 in 1966-67. The group indices for foodgrains and non-foodgrains were 130.3 and 134.1 respectively in 1973-74. The performance of individual crops, however, varied from crop to crop the index of wheat production showing the highest increase from 110.1 in 1964-65 to 237.3 in 1971-72. However, there was a set back to wheat production in the following years. Compared to wheat, progress in rice production was extremely slow—the production index moved up only by 11.5 per cent from 115.7 in 1964-65 to 129 in 1973-74. Among coarse cereals, the performance of bajra and maize was good but production index of jowar showed a decline. Production of pulses showed a secular trend of decline mainly on account of gram and tur. Among commercial crops, production of oilseeds was marked by large fluctuations. Taking the five major oilseeds together their production attained a record level of 9.26 million tonnes in 1970-71 but declined to 8.68 million tonnes in 1973-74. In the case of cotton, there was a significant improvement in production from 1971-72; the evolution of new varieties like hybrid 4 and MCU 5 was largely responsible for this increase. There had also been a qualitative improvement in cotton production insofar as the superior long staple varieties recorded a substantial increase. Production of jute and sugarcane was marked by considerable ups and downs during the period under review. Among plantation crops, tea recorded a steady increase in production while that of coffee showed large year-to-year fluctuations. Taking the extended period of 1960-61 to 1973-74, the average annual compound growth rate of agricultural production worked out to 2.07 per cent and that of foodgrains and nonfoodgrains 2.28 per cent and 1.68 per cent respectively.

1.3.23 Under the new strategy, stress was laid on greater adoption of science and technology for raising productivity. The index of productivity (triennium ending 1961-62=100) increased from 94 in 1966-67 to 124.8 in 1970-71. A consistent increase in productivity was recorded by wheat crop. Index of wheat yields increased steadily from 130.7 in 1968-69 to 164.7 in 1971-72 but showed a decline thereafter, in respect of rice, the index showed only a modest increase from 104.2 in 1967-68 to 115.6 in 1973-74. Indices of yield of bajra and maize attained peak levels in 1970-71 but suffered a setback thereafter; bajra, however, staged a recovery in 1973-74. In the case of jowar, yields showed a consistent decline

from 1967-68 to 1972-73. Among commercial crops, cotton yields registered a significant increase in 1971-72 with the index rising to 144.9 from 118.1 in 1967-68. In general, commercial crops showed considerable year-to-year fluctuations; even so, the levels achieved in 1973-74 were higher as compared to those of 1967-68. Taking the period 1960-61 to 1973-74 the compound rate of growth of agricultural productivity worked out to 1.24 per cent per annum against the corresponding rate of 0.47 per cent per annum in respect of area. Thus a major part of the increase achieved in agricultural production was due to improvement in yield rates.

1.3.24 The general performance of important crops Statewise, during the triennium 1971-72 to 1973-74 compared to that of 1962-63 to 1964-65 is briefly discussed. The former triennium reflected peak production performance of crops before the introduction of high yielding varieties while the latter reflected the impact of the new technology.

1.3.25 Production of wheat recorded significant increases in all major wheat growing areas, *viz.* Uttar Pradesh, Haryana, Punjab, Rajasthan, Bihar and Madhya Pradesh. The increases were in the range of 78 to 165 per cent in the first four States. Greater irrigation facilities and greater spread of new varieties facilitated this development. In the case of rice, taking together the first ranking five States *viz.* Bihar, West Bengal, Orissa, Uttar Pradesh and Madhya Pradesh, and also Assam which accounted for more than seventy per cent of the paddy area, increase in production was unimpressive, being less than 20 per cent during the decade. In Bihar, rice production remained almost stagnant and in Orissa it even registered a marginal decline. Only 15 to 33 per cent of paddy area in these States received irrigation, spread of high yielding varieties was also limited with the exception of Andhra Pradesh in both respects. Moderate increase in rice production ranging from 22 to 38 per cent was reported from Kerala, Karnataka and Tamil Nadu and impressive increases of 142 per cent and 241 per cent respectively from Haryana and Punjab. Large scale diversion of area enjoying irrigation facilities from low value crops to paddy and adoption of high yielding strains, brought about this marked increase in production in the northern States.

1.3.26 Among cereal crops, the most disappointing performance was that of jowar. All the major, jowar growing States, except Karnataka, recorded a fall in production. There had been no significant progress in terms of high yielding varieties. The progress recorded in the case of maize was not steady; among the major growing States some sizable increase in production was observed only in

Punjab and Uttar Pradesh. In the case of bajra, significant increase in production was recorded in Haryana, Gujarat and Rajasthan of which the latter two States accounted for more than half of the area under the crop.

1.3.27 Among commercial crops, performance of cotton was uneven. In Maharashtra and Madhya Pradesh which accounted for a major share of the cropped area, there was a decline in production. However, perceptible improvements were observed in other important cotton growing States like Andhra Pradesh, Karnataka, Punjab, Rajasthan and Tamil Nadu. In the case of jute, there was a fall in production in West Bengal and Bihar whereas in Assam there was a moderate increase of about 25.6 per cent. Groundnut is grown mainly in Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka; there was a set back in its production in the first two States and a significant increase in the other States. Production of sugarcane showed a moderate increase in all the major growing States except Bihar. Nearly three-fourths of the area sown to the crop received irrigation.

1.3.28 The performance in recent years clearly shows that the main factors affecting or influencing agricultural production are : availability of irrigation facilities, adequate and timely rainfall and spread of high yielding varieties. Use of fertilisers and adoption of plant protection measures too had an important bearing on the performance of crops. Measures of land reclamation during the earlier plan period, and multiple cropping during the later years, partly contributed to growth in area under the crop. Other supporting measures such as soil conservation and land development, consolidation of holdings, agricultural credit, agricultural marketing, research and education and price incentives also directly or indirectly influenced agricultural growth.

Animal Husbandry

1.3.29 Livestock rearing in India is generally pursued by small farmers as an occupation subsidiary to crop production. The burden of numbers and poor quality of stock contributed to low productivity. Policies for animal husbandry development were generally aimed at better breeding and feeding and protecting the stock against diseases.

1.3.30 Between 1951 and 1961, livestock population in the country increased by 15 per cent from 293 million to 336 million. But there was a deceleration in growth thereafter, as the increase was only 5 per cent between 1961 and 1972. The number of cattle in 1972 was 179 million as against 176 million in 1961; but that of buffaloes showed greater increase, particularly between 1966 and

1972. There was no significant increase in the population of sheep from 1951; but that of poultry had been increasing steadily even since 1940.

1.3.31 The annual milk production in the country was estimated at 17.1 million tonnes in 1940, 17.4 million tonnes in 1951, and 24.7 million tonnes in 1973. In per capita per day terms, the availability of milk worked out to 150g in 1940, 132g in 1951, and 118g in 1973. Thus, in spite of a large bovine population, the per capita availability of milk was not only low but also showed a decline. Production of eggs, however, increased during the period, both in absolute and per capita terms. Total production of eggs was placed at 1054 million in 1950-51 and 7700 million in 1973-74 and per capita production at 5.1 and 13.1 respectively.

1.3.32 The work of improving cattle breeds was initiated by the ICAR soon after that organisation came into being. Progress achieved, however, was rather slow. A major problem faced was paucity of sires of approved breeds for breeding purposes. Introduction of artificial insemination at the IVRI provided a promising solution. These efforts were greatly intensified under the plans. A number of key village blocks were set up in selected areas with provision for controlled breeding by superior bulls. The scheme also envisaged castration of scrub bulls and increased production of feeds and fodder. By the end of 1960-61, 407 key village blocks, comprising about 2,000 key village units, were established and over 670 artificial insemination centres were opened. The number of key village blocks increased to 498 by 1965-66 and to 621 by 1973-74. The scheme was reorganised during the Third Plan as key village blocks covered only a limited area and did not make sufficient impact on cattle improvement. An area approach was, therefore, adopted in 1964-65 when the new scheme viz., Intensive Cattle Development Project, was initiated. At the beginning of the Fourth Plan, 31 projects were in operation. Their number increased to 55 by 1972-73 and 7 more were taken up during 1973-74. These projects, while showing some signs of progress did not make the desired impact.

1.3.33 As successful implementation of cattle breeding programmes depended largely on the availability of adequate number of bulls of superior breeds, considerable emphasis was laid on increasing the number of cattle breeding farms in the later plans. Up to the end of 1973, 143 cattle breeding farms were set up in various States; in addition, a few large sized farms were also established in the Central sector to raise selected breeds of cattle and buffaloes. The progeny testing scheme initiated during the Second Plan, was extended in the subsequent plans.

1.3.34 One of the serious problems affecting cattle development was the presence of a large number of uneconomic cattle. Weeding of this inferior stock was, therefore, a necessary complement to the programme of cattle improvement. The Gosadan Scheme was introduced during the First Plan period, as a partial answer to the problem. By 1955-56, about 25 gosadans were set up. Their number increased to 61 in 1960-61 and to 79 by the end of 1970-71. Progress made in implementing the scheme was not upto expectations. However, some decline in the number of unwanted cattle and buffaloes was discernible in recent years.

1.3.35 An important prerequisite of livestock development is the availability of adequate feed and fodder resources. The important developments were setting up of a Fodder Bank during the Second Plan and a Forage and Grassland Research Institute at Jhansi in 1962. In addition, 16 fodder seed farms were set up in various States upto 1968-69. Another 14 farms during the first three years of the Fourth Plan and yet another 8 were proposed to be set up during 1972-73 and 1973-74. Seven regional forage demonstration stations were set up in the Central sector. Several feed compounding plants were also established.

1.3.36 Dairy development in India received a fillip after Independence. The First Plan provided for 27 dairy and milk supply schemes in the State sector. The organisation of milk supply to Bombay and Calcutta constituted the major programme during this period. Dairy development was also initiated in other States such as Andhra Pradesh, Bihar, Madhya Pradesh, Orissa, Tamil Nadu and Uttar Pradesh. During the Second Plan period, 7 liquid milk plants were established and 8 pilot schemes initiated as a prelude to the establishment of more dairy plants. Work was initiated on the establishment of 3 creameries, 2 milk product factories and 31 liquid milk plants. As a result of the measures taken during the Third and Annual Plans 48 liquid milk plants, 7 milk product factories and 37 pilot milk schemes came into operation on the eve of the Fourth Plan.

1.3.37 The Fourth Plan envisaged a multipronged drive for the development of dairy industry. These included measures for improving the functioning of projects already set up completion of the schemes which spilled over from the earlier period, extension of organised dairy industry to smaller towns and setting up rural dairy centres in areas with a population of less than 50,000. Under the Operation Flood Project, taken up during this period, World Food Programme authorities were to supply free of cost 1.26 lakh tonnes of skimmed milk powder and 0.42 lakh tonnes of butter oil, which, when reconstituted into liquid milk by the four metropolitan dairies at Bombay,

Calcutta, Delhi and Madras, would generate funds of the order of Rs 95 crores. These were to be utilised for providing assistance by way of grants (30 per cent) and loans (70 per cent) to State Governments for the expansion of milk processing facilities and enhancing milk production and procurement.

1.3.38 Since the advent of planning, efforts were made for improving the quality and productivity of sheep, mainly through selective breeding and cross breeding. During the First Plan, a programme for development of sheep on a regional basis was drawn up under which three regional centres were established in important wool producing areas. Cross breeding with merino sheep gave valuable results both in respect of quantity and quality of wool produced. A number of sheep breeding farms and wool extension and marketing centres were set up during the Second Plan period. These efforts were continued in the subsequent plans.

1.3.39 In the field of poultry, the aim was mainly to improve poultry breeds, educate farmers in regard to modern poultry farming techniques and supply them with good seed material and other inputs for increasing the production of eggs. The Government set up a number of poultry farms, extension centres and production cum marketing centres on a regional basis for propagation of improved stock. As a result of various measures taken during the successive plans, the poultry sector had made encouraging progress in egg production and also in generating employment. The highest hen housed average production recorded so far was 232.8 eggs over a laying period of 11 months compared to 50 eggs per year from indigenous birds during the pre-plan period. However, considering per capita availability of eggs, the country's production is still far short of requirements.

1.3.40 In the field of animal health, steps were also taken during the successive plan periods to insure livestock population against diseases and epidemics. During the First Plan, eradication of rinderpest received high priority. By the end of 1962-63, about 92 per cent of the total inoculable bovine population were vaccinated against the disease. This programme, as also its follow up schemes, continued during the Third and Fourth Plan periods. Steps were also taken for controlling other animal diseases like foot and mouth disease and black quarter. State biological product centres were strengthened and steps were taken to improve the disease investigation and diagnostic units. Simultaneously, efforts were also directed towards improving veterinary facilities in the country. The number of veterinary hospitals and dispensaries increased from 2,000 on the eve of the First Plan to 9,500 by the end of the Fourth Plan period. The

question of modernising slaughter houses in cities and towns also received attention.

Fisheries

1.3.41 The Royal Commission on Agriculture had recommended that a long term view should be taken on the possibility of developing the fisheries of the country. During the forties, fishery development was given some thought by the Policy Committee on Agriculture, Forestry and Fisheries. Before the advent of planning, several schemes were undertaken to help fishermen and their cooperatives in purchasing their basic requirements like yarn, seed fish and equipment. Fish production during the triennium preceding the First Plan was of the order of 628 thousand tonnes, of which about 70 per cent came from marine sources and 30 per cent from inland sources.

1.3.42 A number of schemes were initiated under the five year plans for raising production and export of fish, improving the economy of fishermen and developing facilities for storage, processing, marketing and transport of fish. The average annual catch of marine fish steadily increased from 446 thousand tonnes during the pre-plan period to 1,210 thousand tonnes in 1973 and that of inland fish from 182 thousand tonnes to 748 thousand tonnes during the same period.

1.3.43 In marine fisheries, mechanisation of boats has been the most significant aspect of development. The number of boats mechanised increased from 13 at the beginning of the First Plan to 2,130 by 1960-61 and further to 11,000 by the end of the Fourth Plan. Progress, however was not satisfactory in regard to introducing large size mechanised boats, suitable for deep sea fishing, and construction of fishing harbours. Refrigeration facilities were practically nonexistent in fisheries before 1951. As a result of the continuous efforts made under the plans, sizable capacity was developed in the form of ice plants, freezing plants, cold storage and freezing storages. Extension services, which were absent before the plans, were also developed.

Forestry

1.3.44 During the World War II, enormous quantities of timber of different species were extracted from government and private forests with the result that forest wealth got depleted considerably. Programmes adopted during the pre-plan period aimed at rehabilitation of depleted forests, prevention of soil erosion, extension of afforestation and setting up forest based industries. These post war development schemes continued till 1951 when the First Plan was launched.

1.3.45 Forest development programmes adopted under the plans were intended to realise the objectives of the National Forest Policy of 1952. Some of the important schemes initiated during the first two plans related to creation of plantations of economically important species, establishment of wild life sanctuaries, rehabilitation of degraded forests and construction of forest roads. A phased programme of raising quick growing species over 1 per cent of the forest area and large scale plantation of industrial timber and fuel wood were undertaken during the Third Plan.

1.3.46 According to forest statistics, area under forests during 1970-71 was 748 thousand sq km or 23 per cent of the total geographical area, as against 718 thousand sq km or 22 per cent of the total geographical area in 1950-51. The increase under forest area was mainly due to transfer of forest land from private to public ownership and their inclusion in forest area statistics. During this period, the area under reserved and protected forests increased from 462 thousand sq km to 603 thousand sq km and area under improved commercial species like teak wood and sal from 82 thousand sq km to 118 thousand sq km. Regeneration and afforestation activities covered an area of 1.5 Mha in 1968-69 compared to 1.1 Mha in 1950-51 and 0.3 Mha in the pre-Independence period. Area under working plans increased from 259 thousand sq km to 358 thousand sq km during the same period. The total quantity of industrial and fuelwood produced in 1970-71 was 21.7 million cubic metres valued at Rs 108 crores as against the outturn of 15.8 million cubic metres valued at Rs 19 crores during 1950-51 showing thereby an increase of nearly 38 per cent in quantity and 468 per cent in value in a period of 20 years. The total value of minor forest products, some of which earned sizable foreign exchange during 1970-71, was estimated at Rs 34 crores as against Rs 7 crores during 1950-51.

1.3.47 Up to the early period of 20th century, no specific measures were taken for the preservation of wild life with the result that indiscriminate hunting and senseless killing led to the extinction of a few species and drove some to the verge of extinction. In 1935, a campaign on wild life was undertaken which resulted in some concrete measures for their protection. A number of sanctuaries were established in the country. The National Forest Policy of 1952 emphasised the need for affording protection to animal kingdom, particularly to rare species such as lion and one horned rhinoceros, which were fast disappearing. There are at present five national parks and 126 sanctuaries in the country covering an area of 23,000 sq km.

Foreign Trade

1.3.48 Judged by the value of agricultural exports as compared to the total value of agricultural imports, India is a net exporter of agricultural commodities. The position has remained unchanged since 1950-51, except in 1966-67 and 1967-68 when massive imports of cereals upset the trend.

1.3.49 Among crop-based commodities, the value of exports of coffee, tea, cocoa and spices recorded a steady increase and touched peak level of Rs 248.1 crores during 1973-74 compared with Rs 107.3 crores in 1950-51. The value of export of oilseeds, oilnuts and oil kernels, however, registered a decline from Rs 17.3 crores in 1950-51 to Rs 0.23 crores in 1965-66. Thereafter, these exports recorded a steady increase and touched the level of Rs 6.8 crores in 1972-73 and Rs 37.3 crores in 1973-74. Other important export items showing a steady increase in value during 1950-51 to 1973-74 were crude vegetable materials, crude rubber and rubber manufactures, feeding stuff for animals, textile yarn fabrics and related products, sugar preparations and fruits and vegetables.

1.3.50 Among crop-based commodities, cereal and cereal preparations constituted the major item of imports. Cereal imports registered an uptrend from the Second Plan period and touched the peak level of Rs 651 crores in 1966-67. Imports declined steadily thereafter, consequent on increased domestic production, to touch the level of Rs 80.8 crores in 1972-73. However, these imports were again stepped up during 1973-74 following a setback in wheat production in the preceding year. Cereal imports in that year amounted to Rs 473.2 crores.

1.3.51 Among animal husbandry products, imports were higher than exports in the case of live animals, dairy products, wool and animal oils and fats, while for certain other products such as meat and meat preparations, hides and skins and leather and leather manufactures, exports far exceeded imports. Taken as a whole, livestock products made a significant contribution to the country's foreign exchange earnings.

1.3.52 In the case of fisheries, improvement in catch and in refrigeration and storage facilities had a significant impact on exports of fish and fish preparations. The value of their exports increased from Rs 2.5 crores in 1950-51 to as much as Rs 88.1 crores in 1973-74. Among forestry products, exports of wood, lumber and cork and manufactures thereof showed a significant increase. However, imports of derivative products, such as pulp and waste paper, paper, paper board and manufactures thereof, registered a significant increase.

1.3.53 Imports of fertilisers had to be considerably stepped up to support the intensive cultivation programmes. These imports increased from Rs 9.6 crores in 1960-61 to Rs 162.8 crores in 1973-74. Agricultural machinery was another item which showed sizable increase in imports in recent years.

Current Agricultural Situation

1.3.54 The foregoing review of the progress of agriculture reveals that the current agricultural situation in the country evokes neither pessimism nor optimism. There is no denying the fact that as a result of more than two decades of planning significant advances have been made in all fields of agriculture including animal husbandry, forestry and fishery. In foodgrain production, the annual compound rate of growth of 2.7 per cent achieved during 1949-50 to 1973-74 exceeded the population growth of 2.1 per cent. In spite of this, the food deficit apparently persists. Certain obvious factors responsible for the situation are the increase in demand for foodgrains as a result of increase in incomes and unequal distribution of available supplies over different regions and different income levels. In 1970-71, production of foodgrains touched a record level of 108.4 million tonnes, 68.9 million tonnes in *kharif* and 39.5 million tonnes in *rabi*. The general feeling was that a solution to the food problem had either been found or was round the corner. Record crops were harvested in recent years in the case of all major cereals. In August, 1970 when the National Commission on Agriculture was set up, the atmosphere was one of optimism. The Resolution mentioned that while a notable breakthrough had been achieved in respect of one or two crops, there were promises of similar prospects in respect of other cereals and some nonfoodcrops. The emphasis was, therefore, put on diversification of agriculture and extension of new technology to horticultural crops also.

1.3.55 Improved, early maturing and high yielding varieties of seeds constitute the main plank of the new strategy of agricultural development. The introduction of high yielding varieties made a significant impact on production of cereals. However, several problems cropped up. In the case of rice, yields in the main *kharif* season did not pick up, whereas they did so in the summer season when good water management and disease free conditions could be assured. In the case of wheat, yields of new varieties moved up steadily between 1968-69 and 1971-72 but these levels could not be sustained during the years which followed for various reasons.

1.3.56 The comparatively better performance of wheat in recent

years was made possible by a number of factors. More than two-thirds of the area under wheat in the fertile Gangetic plains are irrigated. Lands having been consolidated, farm operations are more efficient and use of input economical. The rapid success of wheat has made the peasantry progressive and responsive to new ideas. On the other hand, rice is grown mostly in wet humid climates at relatively high temperatures. Excessive rainfall creates problems of drainage; in addition, cyclones and floods are not infrequent in these areas. The conditions under which rice is grown are very congenial for the growth of pests and diseases. Holdings are generally small and scattered, which also come in the way of optimising operations and inputs. Moreover, it took long to realise that the same varieties of rice would not be suitable for the varying conditions of soil and climate under which rice is grown in different parts. In order, therefore, to achieve a breakthrough in rice production, as in the case of wheat, it is necessary to take up extensive land improvement measures including consolidation and drainage, develop efficient methods of water use and evolve varieties suited to different agroclimatic regions and different seasons. In fact, some location-specific varieties have already been evolved and are being tried extensively on farmers' fields. A breakthrough in rice is likely if this strategy is systematically pursued.

1.3.57 The present low yields point to the scope and urgency of exploiting the potential for improvement in several directions. In the first instance, the scientists should evolve varieties suited to different areas. In the case of wheat particularly, there is need to multiply new strains rapidly to replace Kalyan-sona and renew seeds after every 3 to 4 years. Secondly, necessary inputs such as water, fertilisers, pesticides and credit should be made available to farmers in time and at reasonable prices and brought within easy reach. Thirdly, facilities for storage, processing and marketing and price incentives should be ensured. Above all, knowledge about improved cultural practices has to be transferred as a package to cultivators through appropriate extension measures. In the extension programme, management aspects are equally important. For the purpose of minimising the use of pesticides and preventing pollution, an integrated pest control system should be adopted.

1.3.58 The fact that some of the improvements outlined above have been achieved in practice in some areas and with some crops promises the possibility of their extension to other areas and crops as well. Potentialities for increasing crop production in irrigated areas where water supply is assured are enormous and easy of attainment through adoption of a package of measures. Potentialities also exist in areas with assured and adequate rainfall. In the heavy rainfall

areas, control of excessive water in certain seasons is the only answer. But, by and large, the problems of areas with low rainfall and high variability still remain to be tackled. Even in these areas, attempts are being made through dry farming research and development projects to modify existing practices and evolve new ones. Breakthrough in crops grown in such moisture deficit areas would further enhance production possibilities. Fields of animal husbandry, fisheries and forestry also offer wide scope for advances in production.

4 SOME ECONOMIC ASPECTS

Production Base of Agriculture

1.4.1 Operational holdings involved in farming at the beginning of the present decade numbered 70.5 million and covered over 162 Mha. The agricultural work force consisted of over 78 million cultivators and above 47.5 million farm labourers, some of whom were in fact share croppers. Seventy per cent of farmers belonged to the category of marginal and small farmers operating up to 2 ha. As their share of land was only 21 per cent of the total operated area, there was greater concentration of farm based labour and bullock power on these farms, leading to intensive cultivation and greater output but at a higher cost. About 60 per cent of the arable land was held in larger units of more than 4 ha in size, which constituted only 15 per cent of the total units. While marginal and small farmers were the mainstay of paddy cultivation, majority, of wheat growers belonged to the group of medium and larger farmers operating more than 4 ha. The power needs on farms were provided mainly by draught animals and supplemented by machinery like pumpsets and tractors. But, on the whole, power availability was considered inadequate to meet the needs of intensive crop husbandry. Capital investment in crop production was not commensurate with the role and importance of the sector in the national economy.

Crop Farming

1.4.2 The farm situation in the fifties, when no significant technological changes had taken place in crop production, generally reflected the factor endowment pattern of different size groups. Small farms having abundant supply of labour and large farms with more land managed to secure higher farm business income per unit, leaving medium farms at some disadvantage. However, on a per capita basis, income from crop production on small farms was inadequate. The

main factors which accounted for higher farm income were irrigation, intensity and diversification of cropping and better management while the excess number of bullocks was a drag, particularly on smaller farms. Judged by the yardstick of a minimum income, taken as viability norm for farm households, only medium size holdings of 4 ha and above in irrigated tracts and larger holdings above 8 to 10 ha elsewhere were found to be viable units. The low level of performance and farm income was primarily due to the absence of a suitable technology, under existing conditions; even fertilisers were not acceptable.

1.4.3 The IADP introduced with a view to improving farming and achieving immediate increases in cereal production succeeded only partially in regard to the first objective but was handicapped so far as the latter objective was concerned for want of suitable crop varieties. However, cash inputs emerged as an equally important determinant in farm production alongwith land and labour in the new technology that was propagated.

1.4.4 The high yielding strains, exotic as well as locally identified, brought about a material change in the situation particularly in wheat. Wheat varieties proved to be an instant success because of the very sizable margin of profit they brought compared to local varieties. Paddy varieties took more time to gain popular acceptance due to lack of acceptable varieties with adequate yield potential and also problems of pests and diseases and inadequate irrigation, drainage, financial resources and price incentives. Predominance of small farms and tenancy in the traditional paddy areas also cast their shadow. New paddy varieties, however, were more popular during the rabi season, presumably because of the poor yields given by competing traditional paddy varieties during that season. The programme relating to new varieties of millet crops too did not move faster except in the case of a few strains of bajra.

1.4.5 The farm management studies conducted in the late sixties indicated a general improvement in the farm situation. They also revealed increasing disparities in income between crop regions. There were clear evidences that agriculture was undergoing a process of transition in most areas. While, as a rule, the process was gradual and slow, it gained momentum and spread in some areas, like the northern wheat tract, but in some other areas, like the monsoon paddy tract, the process remained checkmated.

1.4.6 Cultivation of cash crops like cotton, sugarcane, groundnut etc. helped farmers of wheat growing areas a great deal in modernising their agriculture. However, such opportunities for diversification of cropping were not available elsewhere, particularly in the monsoon paddy areas.

1.4.7 A study conducted in two typical districts in the low rainfall tract showed that high yielding strains fared well compared to local varieties and yielded two to four times more than traditional varieties in certain cases. The yield levels obtained were, however, closely related to levels of adoption of recommended practices. Smaller farms secured higher yields in respect of foodgrains and larger farm in respect of cash crops. Gross output per hectare showed an increase with farm size and unit costs a decline. Only 10 to 20 per cent of the farms could meet their minimum requirements of consumption from crop production. A significant finding of the study was that adoption of the new technology resulted in greater employment and increase in income.

1.4.8 The farm management data relating to the sixties do not adequately reflect the impact of the new high yielding varieties, as at that time, these varieties were in the early stages of adoption with only a few farmers growing them. Later years, particularly the early seventies, witnessed a much wider and faster spread of these varieties. The progress made by wheat varieties was very spectacular. In the case of paddy, while the programme was centred on a few, nonpopular varieties to begin with, some popular varieties were introduced only in recent years. Besides, the estimate of farm income given in farm management studies is also not a true indicator of the well-being of rural households as it excluded a number of secondary flows like income from wage earnings, secondary occupations and rental income. The farm management studies in future should not only reflect the changes and improvements brought about by the new technology but also cover all income generating activities of farm households. It is also necessary to evolve norms of minimum needs taking into account spatial and temporal variations. The following studies may be undertaken:

- (i) An enquiry into minimum rural income, conforming to regional norms of consumption and price differentials. These studies should be repeated every five years before the formulation of a new five year plan.
- (ii) Income and employment potential of farm business including those from sources other than crop production under different agroclimatic situations and according to size of holdings; and
- (iii) Extent of growth of commercialisation in farm business in different agroclimatic regions according to size of holdings and the constraints thereon.

Farm Size—Some Issues

1.4.9 Two significant findings about farming in India are that crop unit area declines with increase in the size of holdings and that gross returns from farm production remain constant over different size ranges when all input factors, including land, are taken into account. It follows that small farms are more efficient production units from the point of view of yield, employment and overall output. It is, however, necessary that farms do not get reduced beyond a certain level, making it difficult for the operators to find full time employment for themselves, their family and bullocks and also secure minimum consumption needs. The size of the economic holding has been variously estimated but it is expected to be much less than two hectares indicated by some authors. Crop production based on new technology and possibilities through mixed farming indicate that a farm, half this size, or even less in some areas, can prove viable provided it is managed properly. The small farms need special assistance by way of credit and suitable organisations which facilitate common use of lumpy inputs like bullock to reduce cost and removal of environmental and operational constraints in farming operations. Sharecroppers, who constitute a significant proportion of the farming community, also need protection. If suitable arrangements are not made to make landlords share the cost with sharecroppers, commensurate with the former's share of the produce, it is likely to prove a hurdle in the spread of new varieties and adoption of new technology.

Irrigation and Mechanisation

1.4.10 In view of the instability in crop production in large areas, it is necessary to accelerate the pace of irrigation development. In spite of the crucial importance of irrigation very limited data are available to indicate its contribution to crop yields. According to reliable estimate based on a village study, the net marginal product from irrigation was about 1.25 tonnes wheat equivalent per hectare. In comparison to the contribution of irrigation to crop production, the water rates charged from beneficiaries in the canal areas are rather low and are not enough even to cover the cost of maintenance of these irrigation works.

1.4.11 Studies indicate that tractorisation facilitates intensive cultivation and diversification of cropping pattern and does not generally lead to displacement of labour. Intensive cultivation implies greater application of labour. If the overall effect on employment is considered, including the new possibilities in secondary areas like marketing and processing of agricultural produce and in ancillary fields like

tractor and machinery maintenance, operation and servicing, an increase in employment is generally indicated as a result of tractorisation. A welcome trend observed in most of the studies is that of withdrawal of family labour from more exacting farm chores in favour of managerial roles at the stage of tractorisation and greater absorption of wage labour, particularly permanent farm servants. Tractorisation has also facilitated diversification of farm business in the direction of mixed farming. The brunt of mechanisation, however, has fallen on the bullock. Cost benefit analysis of tractor use revealed that only large farms could employ tractors on a profitable basis, while its use on the smaller farms generally led to diseconomy.

1.4.12 However, studies presently available cannot be considered adequate enough. Besides, there are very few studies available for paddy areas. It is, therefore, necessary that the problem of tractorisation is studied in greater thoroughness and depth to provide guidance in policy formulation.

Animal Husbandry

1.4.13 The contribution of animal husbandry to farm income is about 7 per cent except in a few areas, like parts of Gujarat and Rajasthan where dairying has been developed as an important activity round milk processing plants or organised on a milk shed basis to cater to milk plants elsewhere, and accounts for major part of the income. About 70 to 75 per cent of households maintaining cattle belong to the category of small and marginal farmers and agricultural labourers. Dairying is thus a small man's business and does not show signs of much commercialisation in the rural areas.

1.4.14 Milk production, when all items of cost that go into the maintenance of animals including feed and care are taken into account, was found to be uneconomic on most of the farms. However, out-of-pocket expenses accounted for only 25 to 30 per cent of the total cost, the rest being farm based items given imputed values. Farmers showed a marked preference for buffaloes as dairy animals in view of the better yield obtained from these animals compared to indigenous cows. The main factors contributing to nonprofitability of milk production are the low level of yields obtained particularly from cows, the composition of the average dairy unit in which nonmilch animals predominate, poor management and absence of marketing facilities for milk and milk products.

1.4.15 However, as in the case of crop production, the available studies relate to the sixties and do not reflect the impact of programmes for modernisation of animal husbandry initiated since mid-sixties and the new trends. The crossbred cows, being popularised

through new programmes, have brought about significant improvements in milk yields comparable to the 'miracle' seeds of wheat and paddy in crop production. The average yield of milk obtained from crossbred cows in certain areas far exceeded that of buffaloes. 'Amul' and 'Dudh Sagar' hold out promise for all round development of mixed farming on healthy lines if appropriate measures are taken to integrate dairying with processing industry on one side, and production of foodgrains and fodder for animals on the other. There is, however, need to carry out studies on different economic aspects of dairying and dairy complexes, such as Amul, in different agroclimatic situations obtaining in the country. These studies should be designed to bring out the potential of dairying both as a means of providing employment with a reasonable level of income and for supplementing income and reducing underemployment. The performance of crossbred cows as compared to exotic breeds, popular indigenous breeds and also buffaloes needs to be assessed critically in all aspects. As dairying is closely linked with crop production, some items of cost are incurred on a 'joint basis.' It is necessary to evolve appropriate procedures and principles of allocation of 'joint costs' to the two sectors and also for evaluation of inputs that go into milk production. It is important that these studies are carried out on the basis of common concepts and procedures for evaluation of inputs.

Fisheries

1.4.16 Tanks are an important source of fish in the eastern parts of India. A study of tanks in Assam, Tripura, West Bengal, Bihar and Orissa showed that most of them were privately owned and nearly 80 per cent of them were of a size less than 0.67 ha. Not all tanks were endowed adequately to take to fish culture; only about 50 per cent of them had more than a metre of water, considered minimum for purposes of stocking. Siltation of tank beds had adversely affected the water holding capacity of tanks. The annual average catch from these tanks was only 260 kg per hectare water spread. The average catch and net profit were comparatively higher in Orissa, where more attention was paid to renovation and maintenance of tanks and stocking them fish fry and fingerlings. Tanks generally provided subsidiary source of income, which ranged between Rs 300 to Rs 580 per tank in West Bengal, Bihar, Orissa, and Tripura. Returns obtained in Assam were very low. Studies in carp culture in tanks have shown that catch from tanks can be increased in 1000 kg per hectare with major carps by following existing practices like stocking and to 5000-8000 kg per hectare if modern practices are adopted and exotic species like grass carp and silver

carp also introduced in a composite programme of carp culture. This cannot be done unless attention is paid to renovation and repair of tanks for which the tank owners would need financial assistance.

1.4.17 The Programme Evaluation Organisation organised a survey of marine fisheries to study the comparative performance of mechanised boats and country boats in 1969-70. The study revealed that in terms of investment, cost, returns and performance, mechanised boats were not more efficient than country boats and that mechanised boats operating in the private sector were more efficient in terms of returns to investment and operational cost than those in the public and cooperative sectors. The least satisfactory performance was that of boats belonging to the cooperative sector. These boats reported the highest unit investment and cost but did not show commensurate returns nor efficiency. Country boats, on the other hand, were more efficient. Considering that average investment and operational cost in respect of country boats were only one-seventh and one-fourth respectively compared to mechanised boats, the average catch obtained by them was as much as 60 per cent of the latter in quantitative terms and one-third in value terms. However, the catch estimates relating to country boats were found to be doubtful. A major limitation of the enquiry was the inadequacy of the sample size of country boats. It is necessary to attempt a more rigorous cost accounting survey of fishing boats with extended coverage of country boats before any definite view could be taken regarding the relative efficiency of different sectors, particularly between the mechanised and non-mechanised sectors. The problem of seasonal variation in fish catch needs to be given special attention, particularly in the case of country boats. In future studies, besides marking a comparison between similar fishing methods adopted by mechanised and non-mechanised boats, the comparative economics of different fishing techniques adopted by mechanised boats like trawling, gill netting, long lining etc should also be investigated.

(Paragraph 1.1.5)

APPENDIX 1.1

Resolution Setting up the
National Commission on Agriculture
No. 25-13/68-Genl. Coord.
Ministry of Food, Agri., C.D. & Co-operation
(Department of Agriculture)
New Delhi, the 29th August, 1970

RESOLUTION

1. Agriculture has a dominant role in the Indian economy contributing nearly half of the national income, providing employment to about 70% of the working population and accounting for a sizeable share of the country's foreign exchange earnings.

2. Population has been increasing at a rapid rate, leading to increase in demand for food and other consumer goods, many of which have an agricultural base. There is a legitimate aspiration of the people in rural areas to improve their standards of living and to share the fruits of development.

3. Rapid improvement in agriculture is possible through advances in research and technological innovations, larger utilisation of inputs and reduction in dependence on the vagaries of weather through irrigation and other improved practices. Recent trends have thrown up vast possibilities of an accelerated growth in Indian agriculture. The experience of the Intensive Agricultural Development Programme (Package Programme), Intensive Agricultural Area Programme and the introduction of the new strategy have shown that the farmers responsive to the adoption of scientific and improved agricultural practices and to the incentive of prices. Notable breakthrough has been achieved in respect of one or two crops and there is the promise of a similar breakthrough in respect of other cereal crops and some non-food crops. There has been increasing evidence of investment in irrigation and other facilities both from private and institutional resources with a view to reducing the dependence on vagaries of weather. The utilisation of technological and non-farm inputs has also been growing at a rapid rate. The development of transport and other facilities is opening up the rural areas and is providing outlet for the farm produce.

4. During the very process of this development, the need for taking measures to ensure that the benefits of the new technology are shared by the bulk of the farming population and are not limited to the better-off class of farmers has become obvious. It has become clear that besides the irrigated areas which permit of intensive development through multiple-cropping and application of inputs in intensive doses, there are large tracts under rainfed agriculture requiring special attention both in the matter of evolution of the appropriate technology suited to those areas and of making available the necessary resources to the farmers. Moreover, currently, while there have been impressive increases in foodgrains, critical shortages are developing in respect of fat and protein produc-

tion. It is, therefore, necessary to diversify agriculture between crops and to extend the new technology to horticultural crops also. The overall objective should be to secure integrated development of agriculture, animal husbandry, poultry, inland fisheries and forestry for ensuring a balanced diet and development.

5. The possibilities of progress in different directions have made it incumbent to take a coordinated and forward view of the different aspects of development. In spheres such as those dealing with the problems of unemployment and reduction in the disparities between the low and high income farmers as well as irrigated and rain-fed areas, urgent action is necessary. The existing arrangements for research and extension which are basic for sustaining the tempo of development have also to be reviewed for coping with the challenges posed by the adoption of new technology and providing a two-way channel of communication between the farmer and the scientist.

6. All in all, it has to be ensured that development of agriculture caters to the welfare of the vast multitudes of population living in the rural areas.

7. It is in this background that the Government of India have taken the decision to set up a National Commission to enquire into the progress, problems and potential of Indian Agriculture. In status as well as in the assignment given to it, the Commission will be of the highest level and Government are confident that its report and recommendations would have a far-reaching and historic impact on the further development of Indian Agriculture in all its aspects.

8. In the context of the agricultural situation described in the foregoing paragraphs, the terms of reference of the Commission will be as follows :

1. To examine comprehensively the current progress of agriculture in India and to make recommendations for its improvement and modernisation with a view to promoting the welfare and prosperity of the people;
2. In particular, investigate and report on the following aspects of agriculture :

3. Crop Production and Land and Water Development.

- (i) Economics of land and water utilisation and the patterns, and scope for expansion of crops for balanced and nutritious food, industrial uses and exports with special reference to the need and scope for development of horticulture;
- (ii) Problems of soil and moisture conservation, particularly those related to the catchment areas of the major irrigation projects on the one hand and the composite implementation of soil conservation measures and improved agricultural practices on the other;
- (iii) Problems of water management and ground water exploitation in relation to other surface irrigation projects, major and minor;
- (iv) Programmes for land reclamation and development with special consideration of the needs of areas affected by soil salinity;
- (v) Requirements of the new strategy of scientific agriculture in the shape of requisite supplies of inputs and production requisites with special consideration of sources of supply and problems and in particular :—
 - (a) multiplication, distribution of high-yielding varieties of seed and other improved seeds;

- (b) propagation of soil nutrients including chemical fertilisers and other organic manures;
- (c) measures for plant protection keeping in view the risk of pollution; and
- (d) agricultural credit from Government, cooperative and other institutional agencies.
- (iv) The scope and long and short-term potentiality for mechanisation of agriculture in the context of the use of advanced technology involving the use of high yielding varieties and adoption of multiple cropping without having adverse effect on rural employment situation.

B. Animal Products, Fisheries and Forestry.

- (i) Development of animal husbandry both for providing nutritious diet to the population, draft power for agricultural operations and income and employment opportunities to the rural population;
- (ii) Development of poultry, piggery, sheep and goats for increasing income and employment opportunities in the rural areas, besides contribution to balanced diet;
- (iii) Measures necessary for disease control in animal population to increase their efficiency;
- (iv) Development of fisheries, marine, inland and estuarine for increasing income and employment opportunities for the weaker section of population dependent for their livelihood on this occupation, besides their contribution to balanced diet and export earnings;
- (v) Development of forestry, including farm forestry as a factor in agricultural progress and as a source of raw material for industry, export as well as for sustaining the ecological balance in nature, and for providing employment opportunities to large sections of tribal and other population living in these areas.

C. Research, Education and Training.

- (i) Achievements, deficiencies and potential of the development of agricultural research and steps needed for promotion of agricultural research and its application to field conditions in the context of fast developing technology; and the need for scientific demonstrations on farmers' fields, for gearing up extension machinery and for the establishment of a two-way channel between farmers and scientists;
- (ii) Education and training of personnel, (a) at the level of Universities and higher agricultural education, (b) middle level training of personnel engaged in occupations ancillary to agriculture, and (c) training of government and other personnel connected with agricultural development;
- (iii) Role of farmers' training and education, and methods of mobilisation of human resources and ensuring people's participation in agricultural development programmes.

D. Organisation and Supporting Measures.

- (i) Examination of the structure and organisation of existing agencies and personnel both government and non-government engaged in the operation of agricultural research and development programmes and

improvements and adjustments necessary to suit the changed requirements for the formulation of policies, preparation of programmes and implementation of action in the field; and the relative role and responsibilities of Central and State Governments;

- (ii) Development of transport, marketing and storage and processing industries with particular reference to food processing to support the programmes for growth in agricultural production, including horticulture and animal husbandry.

E. Employment and Manpower.

- (i) Employment potential of agricultural sector and the implications of the goal of full employment in agriculture for policies and programmes;
- (ii) Scope for pilot projects to demonstrate the types of schemes necessary for creating employment opportunities in the rural areas;
- (iii) Manpower requirements for agricultural programmes and methods of recruitment and training;
- (iv) Problems of small farmers and agricultural labour viewed in the context of social justice and equality of opportunity and as a factor in securing effective participation of the bulk of the India peasantry in stepping up agricultural production.

F. Other Aspects.

- (i) Concept, potential and measures necessary for integrating area development with special reference to dry and rain-fed areas, command areas of irrigation projects and remote, economically backward, hilly and tribal areas;
- (ii) Land reforms, consolidation of holdings and the link between land reforms and agricultural production;
- (iii) Study of agricultural price problems as a policy of incentives for agricultural production;
- (iv) Crop insurance; and
- (v) Availability of reliable and timely agricultural statistics for formulation and implementation of agricultural policies and programmes.

9. The Commission will consist of a Chairman, a Member-Secretary, five full-time Members and ten part-time Members. It has been decided to appoint Shri C. Subramaniam, formerly Union Minister for Food and Agriculture, as the Chairman of the National Commission. Shri J. S. Sarma, Economic & Statistical Adviser to the Ministry of Food and Agriculture, Government of India and Agricultural Census Commissioner has been appointed as its whole time Member-Secretary. The other names will be announced later.

10. The Commission will make its recommendations as soon as practicable and in any case within a period of two years. In particular, the Commission will make interim recommendations on items C(i), D(i), E(i), E(iv) and F(i) of the terms of reference and any other items that it may deem fit.

11. The Commission will be free to set up study teams or Sub-Committees for specific discipline or to study problems in depth. The Commission may also have technical Consultants on whole-time and part-time basis. On any aspect which is covered by the terms of reference of the Commission and which is relevant for its work, if there is any other expert body or Commission going

into these matters, the Commission shall be provided the facility of consultations with such expert bodies and Commissions.

12. The Headquarters of the Commission will be in New Delhi.

13. The Commission will devise its own procedure. It may call for such information and take such evidence as it may consider necessary. The Ministries/Departments of the Government of India will furnish such information and documents and render such assistance as may be required by the Commission.

14. The Government of India trust that the State Governments/Administrations of Union Territories will extend to the Commission their fullest cooperation and assistance.

Sd/-

(T. P. Singh)

29-8-70

Secretary to the Government of India.

(Paragraph 1.1.6)

APPENDIX 1.2

Interim Reports

Report	1	2	3	Date on which presented
1. Multiplication and Distribution of Quality Seed pertaining to High Yielding Varieties and Hybrids of Cereals				November 29, 1971
2. Fertiliser Distribution				—do—
3. Some Aspects of Agricultural Research, Extension and Training				—do—
4. Credit Services for Small and Marginal Farmers and Agricultural Labourers			January 1,	1972
5. Milk Production through Small and Marginal Farmers and Agricultural Labourers			—do—	
6. Establishment of Agro-Meteorological Divisions in Agricultural Universities			—do—	
7. House-sites for Landless Agricultural Labourers		August 21,		1972
8. Production Forestry—Man-made Forests			—do—	
9. Soil Survey and Soil Map of India			—do—	
10. Potato Seeds			—do—	
11. Organisational Aspects of All-India Coordinated Research Projects			March 13.	1973
12. Modernising Irrigation Systems and Integrated Development of Commanded Areas			—do—	
13. Whole Village Development Programme			—do—	
14. Organisation and Functions of the Commodity Development Councils and Directorates			—do—	
15. Reorientation of Programmes of Small Farmers and Marginal Farmers and Agricultural Labourers' Development Agencies			August 16,	1973
16. Poultry, Sheep and Pig Production through Small and Marginal Farmers and Agricultural Labourers for supplementing their income			—do—	
17. Sericulture			—do—	
18. Social Forestry			—do—	
19. Forest Research and Education			April 19,	1974
20. Desert Development			—do—	
21. Certain Important Aspects of Selected Export-Oriented Agricultural Commodities			—do—	
22. Agricultural Price Policy			March 13,	1975
23. Certain Important Aspects of Marketing and Prices of Cotton, Jute, Groundnut and Tabacco			—do—	
24. Some important Aspects of Livestock Production in the North Eastern States			July, 17,	1975

(Paragraph 1.1.7)

APPENDIX 1.3

Chapter Scheme of the Report of the National Commission on Agriculture

PART I—REVIEW AND PROGRESS

1. Introduction
2. Historical Review
3. Progress of Agricultural Development
4. Some Economic Aspects

PART II—POLICY AND STRATEGY

5. Agriculture in Economic Development
6. Growth with Social Justice
7. Policy and Strategy
8. Centre-State relations in Agricultural Development
9. Nutrition

PART III—DEMAND AND SUPPLY

10. Demand Projections
11. Supply Possibilities
12. Export possibilities and Import Substitution

PART IV—CLIMATE AND AGRICULTURE

13. Climate and Agriculture
14. Rainfall and Cropping Patterns

PART V—RESOURCE DEVELOPMENT

15. Irrigation
16. Command Area Development
17. Land Reclamation and Development
18. Soil and Moisture Conservation
19. Electricity in Rural Development

PART VI—CROP PRODUCTION, SERICULTURE AND APICULTURE

20. Reorientation of Cropping Systems
21. Foodgrain Crops
22. Commercial Crops
23. Horticultural Crops
24. Plantation Crops
25. Fodder Crops
26. Sericulture
27. Apiculture

PART VII—ANIMAL HUSBANDRY

28. Cattle and Buffaloes
29. Dairy Development
30. Sheep and Goats
31. Poultry
32. Other Livestock
33. Mixed Farming
34. Livestock Feed
35. Animal Health
36. Meat Production and Animal Byproducts

PART VIII—FISHERIES

37. Inland Fisheries and Aquaculture
38. Marine Fisheries
39. Crustacean Fisheries and their Utilisation
40. Marketing of Fish and Fishery Products

PART IX—FORESTRY

41. Forest Policy
42. Production and Social Forestry
43. Minor Forest Produce
44. Forest Ecology and Wildlife Management
45. Forest Protection and Law
46. Forest Planning, Research and Education

PART X—INPUTS

47. Seeds
48. Fertilisers and Manures
49. Plant Protection Chemicals
50. Farm Power
51. Implements and Machinery

PART XI—RESEARCH, EDUCATION AND EXTENSION

52. Research
53. Education
54. Extension

PART XII—SUPPORTING SERVICES AND INCENTIVES

55. Credit and Incentives
56. Marketing, Transport and Storage
57. Processing and Agroindustries

PART XIII—RURAL EMPLOYMENT AND SPECIAL AREA PROGRAMMES

58. Rural Employment
59. Special Area Development Programmes

PART XIV—PLANNING, STATISTICS AND ADMINISTRATION

60. Planning
61. Statistics
62. Administration
63. Farmers' Organisations
64. International Cooperation

PART XV—AGRARIAN REFORMS

- 65. Land Reforms Policy
- 66. Land Reforms Legislation and Implementation
- 67. Agrarian Structure and Perspective
- 68. Consolidation of Holdings
- 69. Agricultural Labour

2

POLICY AND STRATEGY

1 AGRICULTURE IN ECONOMIC DEVELOPMENT

2.1.1 In India, the vital role of agriculture arises out of the position the agrarian sector occupies in the overall economy of the country. Agriculture is the largest sector of economic activity and has a crucial role to play in the country's economic development by providing food and raw materials, employment to a very large proportion of the population, capital for its own development and surpluses for national economic development. While the development of agriculture seems to hold the key to the progress of the economy as a whole and should receive emphasis the linkage between agricultural and non-agricultural sector also needs to be reorganised.

Agriculture in Indian Economy

2.1.2 The agricultural sector contributes a large share to the national income. During the fifties, it contributed more than half of the national output. In the sixties and the early seventies also, its contribution has been above 40 per cent. The increase in the size of the national output is still substantially dependent upon the performance in agriculture, although its growth rate has been very low.

2.1.3 Agriculture, directly or indirectly has been the main source of livelihood for the majority of the population. It has supported around 70 per cent of the work force without any significant change during the last two decades. The agricultural or more generally the rural sector has also been the supplier of manpower to industry. However, the rate and pattern of investment in other economic sectors have not been such as to draw away surplus rural labour. The slow rate of growth in agriculture failed to create enough opportunities for additional rural employment and resulted in widespread under-employment and unemployment in the rural sector. This has led to migration to urban areas in search of employment, income and better facilities.

2.1.4 Agricultural products—primary produce and manufactures

based thereon—occupy an important place in the country's export trade. Compared to exports, the importance of agricultural products in the total import trade is relatively less. The development of indigenous capacity has resulted in a gradual decline in the proportion of imports to total supplies. Both through exports and import substitution, the agricultural sector has contributed to the earning and conservation of foreign exchange, which is needed for capital and maintenance imports for the development of the economy.

2.1.5 While agriculture held an important place in the national economy, its efficiency remained at a low level. Over vast areas in the country agriculture has continued to be traditional in character, resulting in low yields, limited income and lack of capacity to invest. A modern sector has, however, been developing on a limited scale side by side. In these areas, in contrast, notable success has been achieved in yield rates and total production, income generation as well as investment which has had considerable impact on the life and economic activity of the people.

2.1.6 During the process of development, the interdependence between agricultural and industrial sectors has become stronger. The close interdependence is reflected in (a) the supply of raw materials and inputs from agriculture to industry and *vice versa*; (b) the supply of wage goods to the industrial sector; (c) the supply of materials for the building up of economic and social overheads in the agricultural sector; and (d) the supply of basic consumption goods to the agricultural population. Experience shows that while growth and diversification of agricultural production have helped develop various types of industries and diversification of employment, shortfall in agricultural growth in some years had deleterious effect on prices causing all round imbalances and hardship. It is also clear that further growth in agricultural production is materially dependent on the rapid increase in the production of input supplying industries.

2.1.7 As development gained momentum, there was more emphasis on the creation of productive assets in agriculture—in variety as well as in quantum—particularly in areas which had been exposed to new technology. Much more investment, both public and private, has been made in agriculture compared with the preindependence period, public investment playing a dominant role. But it is felt that the redeployment of part of the deposits mobilised by the banks in rural and semi-urban areas was inadequate considering the needs of the rural areas, particularly agriculture.

2.1.8 In the current stage of the country's development, agriculture occupies a central place in the national economy. Its performance has set the pace of growth of the economy as a whole. But

the agricultural sector grew at a rate much below its potential; the growth rate hardly keeping pace with the population growth and requirements of the economy. The impact of new technology has not been sufficient to alter significantly the trend rate of growth in crop production. The rapid growth of population on the one hand and the inadequate growth of agriculture on the other have led to several unwelcome developments. There has been only a marginal increase in per capita availability of foodgrains and actual decline in the case of milk and meat. Rising prices of agricultural products setting off a chain reaction and imposing hardship on the masses, increasing disparity between rural and urban incomes and mounting pressure on land and increasing rural unemployment and underemployment are the other important consequences following sluggish growth in agriculture. The declining share of agriculture in the total output of the country does not reflect a significant structural transformation of the economy. The decline will be meaningful after a sound agricultural base has been laid and the potential more fully exploited.

Role of Agriculture in the Future

2.1.9 A strong foundation of agriculture is a necessary condition for sustained and rapid economic and social development in India. Agriculture can contribute substantially to the improvement of the rural as well as the overall economy and has the potential to become the leading sector in development. A more dynamic role is, therefore, envisaged for this sector in the future.

2.1.10 In dealing with the problems of growth and development of the Indian economy, the main focus will have to be on the rural sector. The rate and pattern of industrialisation do not promise any significant structural transformation and large scale transfer of population from rural to urban activities. As a result, the rural economy will be required to support a vast and growing population. The agricultural sector will be required to shoulder great responsibility in providing food and nutrition to both rural and urban population, industrial raw materials, employment, capital and exchange earnings. Adequate production of foodgrains as well as supplementary protective foods are necessary for improving the diet and thereby nutrition.

2.1.11 In the future, as planned effort is made to expand wage employment, it will be necessary to generate a large surplus of wage goods for their sustained supply to the working population both in urban and rural areas at reasonable and stable prices to impart sufficient stability to the economy for planned development.

2.1.12 Larger production of both foodgrains and important cash

crops will help to reduce or eliminate imports and thereby release foreign exchange resources for the development of other sectors of the economy. Self-sufficiency in foodgrains, animal husbandry products and agricultural raw materials will result in substantial savings in foreign exchange. Demand projections made in the Report underscore the need for substantial expansion in the production of agricultural raw materials to avoid imports and ensure uninterrupted functioning of agro-based industries. Simultaneously, greater effort to utilise the export potential in several agricultural products including processed items will increase foreign exchange earnings, the accent shifting gradually from primary produce to processed products and agro-based manufactures to realise higher exchange value per unit of exports and to create employment within the country.

2.1.13 The agricultural sector has to absorb a large proportion of the increase in population in the rural sector and provide gainful occupation to the existing unemployed and underemployed even after deliberate effort is made to expand non-agricultural activities. Scientific cultivation can substantially augment labour requirements.

2.1.14 Rapid expansion of irrigation facilities will enable the cultivators to put large areas under multiple cropping. Also the adoption of improved technology and scientific land utilisation in vast rain-fed areas will not only reduce the variability in production but also enhance output. However, the scope for full time employment generation through crop production alone being limited, the accent on the development of horticulture, animal husbandry and fisheries will have to be much more than before to provide adequate employment particularly to small and marginal farmers and agricultural labourers as these are labour intensive activities. Attention in this direction will also result in large availability of protective foods. Forestry activities—production forestry, social forestry as well as the development of minor forest produce—can lead to much larger employment. Further, as the economy develops and incomes rise, the demand for processed and high quality foods will expand stimulating activities in the secondary and tertiary sectors like processing, packaging, marketing, etc. and creating additional employment opportunities. If agriculture is developed on the right pattern and appropriate supporting institutions and infrastructures are created, the benefits of development will be widely shared and imbalances as in the past, will not develop. This aspect of distributive equity is discussed in the next section.

2.1.15 The positive nature of the interaction between agriculture and industry will stimulate and reinforce the development of both the sectors. Lack of growth in agriculture, and, therefore, lack of purchasing power among the vast agricultural population, can be a serious

limiting factor to the growth of both agricultural and industrial sectors. The creation of economic and social overheads in the form of irrigation facilities, roads and transportation, electrification, markets, etc. will aid the process of growth of the economy through both backward and forward linkages and generate substantial off farm employment. Agricultural development will also lead to greater non-farm activities like education and training, research and extension as well as building up of organisations for providing supplies and services thereby expanding the scope for employment and development of expertise. The creation of enough surpluses in agriculture by increasing productivity through modernisation and technological improvements and mobilisation of savings is essential for economic development. However, the transfer of resources so mobilised to non-agricultural sector should be so regulated as not to trench the capital needs of modern agriculture.

2.1.16 The compulsions of agricultural development arise from the role of agriculture in the development of the economy in the future. The agricultural sector has to grow at a rate much faster than before for its own sake as well as for the sake of economy as a whole. It has a large potential to contribute to the national output and at the same time provide direct employment and income to the numerically larger and vulnerable sections of the society. In formulating the future policies and strategies of development of agricultural as well as national economy, these considerations should be kept in view.

2 GROWTH WITH SOCIAL JUSTICE

Poverty

2.2.1 The imperative need for measures to secure effective participation of the bulk of the Indian peasantry in the process of agricultural development arises from the deficiencies in the rural socio-economic set up and the prevalence of widespread poverty. Over the years there has been a deterioration in the situation as the number of people living below the desirable minimum levels of living increased. The rise in the number of landless agricultural labourers viewed in the context of extremely inadequate job opportunities points to the same conclusion.

2.2.2 While improvement of the living standards of the people and welfare of the society were the main objectives of development, the accent in the first three five year plans was on overall growth; programmes were not specifically designed for the removal of poverty. Agricultural development did not receive adequate attention under the Community Development Programme. Whatever services were pro-

vided under it as well as those under the Intensive Agricultural District Programme went largely to the more affluent sections thus accentuating the existing disparities.

2.2.3 The Fourth Plan was more articulate about the need for special efforts to alter the skewed pattern of income distribution and provided for separate schemes for the development of backward areas and the weaker sections. In the Fifth Plan removal of poverty has become a primary consideration for formulating programmes.

2.2.4 The low productivity of land and labour is among the principal causes of rural poverty. Other contributory factors include inequitable land relations, institutional inadequacies and lack of infrastructure. Rural development has so far failed to create enough opportunities for employment for the growing labour force. In spite of the growth of the national economy, the employment situation has worsened due not only to low rate of growth but also capital intensive investment and inadequate emphasis on agricultural development programmes. There has, therefore, been certain disenchantment with growth as the sole objective of planning.

Growth and Social Justice

2.2.5 The future policy of agricultural development should, therefore, attempt to combine growth with social justice. Growth *per se* is important as without it no progress can be achieved. But it is the manner in which growth is obtained that is of crucial importance from the point of view of generation of employment and amelioration of the poor.

2.2.6 In order to make a significant impact on the problem of rural poverty while achieving sustained growth, it will be necessary to secure the involvement of the weaker section of the rural population in the very process of growth as this is the only way to transform the economic and social conditions of small and marginal farmers and landless agricultural labourers, rural artisans and others engaged in traditionally poor occupations. For this, changes in the productive system of agriculture and the occupational structure of the rural community will be essential. The main thrust should be on the creation of large-scale opportunities for productive employment with a view to raising the level of income of the less privileged among the rural population through increased production. The policy should be not only to reduce inequality among the various strata of the rural society but also among different regions by paying special attention to the need of underdeveloped areas like hill, desert and drought prone areas and tribal areas.

2.2.7 Both the agrarian structure and the institutional arrangements will require fundamental changes for widely diffusing agricultural production activities with accent on labour utilisation and yield improvement. It would be necessary to redefine land relations and create conditions for intensive and scientific use of the available land resources by small farmers, tenants and sharecroppers for increased employment, output and income. Land reforms must be considered as the basis to ensuring growth with social justice. In the context of the predominance of small sized farms and low level of output, layers of intermediary interests sharing the small produce will only perpetuate poverty. Tenancy in such a situation is clearly untenable except perhaps in very special cases. State policy should be to encourage peasant proprietorship with the necessary backing of supplies and services to derive the maximum benefit out of small pieces of land.

2.2.8 A defective land tenure system is a hindrance to intensive application of labour, increased production as well as modernisation. Higher production through a labour intensive modern technology requires a high degree of social and economic equality among the rural population. Land reforms as a means of improving distributive justice is likely to have desirable effect on raising the productivity of agricultural labour through extended employment, higher income and consumption. To ensure, therefore, that the small farmers and landless labourers are also able to share the new opportunities provided by modern technology, land reforms must constitute the basic ingredient in the process of modernisation. Without appropriate measures to protect the poorest sections of agricultural population, the introduction of improved technology can only result in increasing disparities and can lead to a dangerous disequilibrium in the rural economy and the rural society.

2.2.9 Along with land reforms, it is essential to ensure access to the means of production and marketing facilities. The new strategy in agricultural development is neutral to scale and has opened up vast possibilities for rural growth and development. But the full utilisation of its potential is possible if neutrality in respect of the scale of operation is practised also in the matter of wide range of supporting services including the supply of water, fertilisers, pesticides and credit as well as marketing facilities. The State will have to play its role in order to ensure justice to the small and marginal farmers by evolving proper irrigation, drainage, pest and disease control programme on an area basis for equitable distribution of benefits. The entire programme will then become credit worthy and neutral to scale enabling small and marginal farmers to fully utilise credit and inputs to much the same relative extent and in much the same manner as large farmers

do. Special efforts have to be made to bring the rural services within easy reach of small and marginal farmers and agricultural labourers since much of the difference in returns from large and small holdings is directly attributable to differences in access to and unequal sharing of the rural services. Failure in this regard will mean the emergence of a more pronounced dualistic agriculture and the accentuation of the disparities.

2.2.10 The differential growth rates even in irrigated areas highlights the limited spread and uneven adoption of modern technology. There is considerable leeway to be made up between district and district to attain comparable levels of output per hectare so as to maximise the returns on large State investments in irrigation projects and other infrastructural developments. Such action will increase opportunities for employment and income in these irrigated areas through sustained and widespread diffusion of the benefits of development over more areas and among larger number of people.

2.2.11 Drought prone areas are marked by very low and unstable yields from crop production and constitute a major factor contributing to regional disparities in the country. Inadequacy of water being a major constraint in the improvement of economy of the farming community, the State should assume responsibility to plan for irrigation schemes as a matter of priority in areas where surface water schemes or larger scale ground water schemes are possible. Moreover, since the scope for irrigation development in these areas is limited, the State should as a national policy explore the possibility of diverting surplus water from one part of a river basin to another or from other river basins to give minimum irrigation support to these areas.

2.2.12 Necessary backing of research, extension and services will have to be provided and sufficient funds earmarked for research which should be directed towards evolving suitable crop varieties and practices in areas with different rainfall conditions so as to extend the benefits of scientific agriculture to more crops and areas.

2.2.13 While crop production has its own importance, animal husbandry suitably supported by range management in natural grasslands and pasture development on village common lands will be a more stable base for supplementing and sustained income to the vast section of the rural population in dryland drought prone areas. Improved range management practices would also restore ecological balance in these areas.

2.2.14 Apart from these vulnerable areas, special attention has to be paid to backward regions like hill and tribal areas, which, because of their social, economic and political limitations or peculiarities have so far been outside the mainstream of development in the country.

In fixing priorities for development and deciding upon the pace of such development, due consideration should be given to such specially backward areas. Development of infrastructure in such areas will need priority attention. Larger State assistance would be called for to activise these areas.

2.2.15 Since crop production alone may not give adequate employment and a minimum level of income to the bulk of the rural population particularly in low rainfall areas, it is necessary to diversify rural employment opportunities by developing suitable subsidiary occupations such as dairying, rearing of poultry, sheep and pig, fish farming, bee keeping and sericulture. These subsidiary occupations would provide gainful employment to the farming community particularly the female folk throughout the year and more so to those raising a single crop in rainfed areas. Likewise development of forestry and fisheries has considerable scope for creating additional employment opportunities for the rural people. The benefits of expanded forestry activities should be made to accrue to unemployed and underemployed by making suitable changes in the existing system of utilisation of forest produce. Programmes of intensive fish culture by fishermen families could substantially augment their income and improve their living standards.

2.2.16 Rural labour could increase their productivity and earnings if they are given training to appreciate and adopt modern technology in agriculture and allied activities including rural crafts and small scale industries. Rural employment policy should, therefore, have the objective of providing intensive training to the rural working force in all production activities including the imparting of new skills in which they are traditionally engaged. In the training programme emphasis should be laid on promoting functional literacy among the rural women so that the vast rural women power is effectively harnessed for improving the rural life in general.

2.2.17 Disparate development in incomes and living standards in the rural and urban sectors of the economy has led to widening inequality in income distribution between rural and urban areas. The failure to emphasise specific programmes for productive employment in the rural sector is at the root of the continuing problem of rural urban differential in growth rates. The State policy must be to force the pace of development in rural areas and achieve higher rate of growth in rural incomes. The accent should not only be on increasing agricultural employment and output but also on the development on secondary and tertiary sectors both for meeting the increasing demands for rural services such as credit, marketing, transport and trade etc. and increasing the prospects of employment and incomes in the rural areas

through greater diversification. Decentralisation of industries and services would be the means through which such a diversification could be achieved. Necessary support to rural craft will be required for fuller utilisation of the local skills. Only such measures can tackle the problems of unemployment and underemployment in the rural areas as well as the problem of rural-urban disparity.

2.2.18 The amelioration of the poor in the rural areas cannot however, be accomplished quickly because of the limitation of resources. However, every effort has to be made to continuously move in the direction in the removal of poverty and inequality and reduction of regional imbalances. These considerations provide an important basis for the future agricultural development policy in the country and have been kept in view while formulating our approach to and making our recommendations on the development of agriculture and the rural economy in India.

3 POLICY AND STRATEGY

Policy Objectives

2.3.1 In order to facilitate the establishment of prosperous egalitarian rural society, the agricultural policy should lead to (a) adequate supply of goods and services to sustain a rising standard of living and (b) sufficient employment and income opportunities for the masses, which generate effective demand for these goods and services and enable them to enjoy the benefits of development. The main thrust of the policy should be to secure demand supply balance in various agricultural commodities as well as distributive justice over a period of time. The anticipated demand situation in the time perspective of 1985 and 2000 AD clearly indicates the magnitude of effort involved in matching the emerging demands with adequate supply of agricultural commodities. A rapid rate of growth in agricultural production becomes imperative, and has to be planned for. Investment policies should seek to allocate resources within agriculture to secure both efficiency in production and generation of maximum employment opportunities. In the choice of technology the labour surplus situation in the country should be kept in view. For sustained investment in agriculture, rural savings will have to be mobilised.

2.3.2 For building a forward looking dynamic and diversified agricultural economy, effort should be directed towards an integrated development of crop production, livestock and poultry, fisheries, and forestry and simultaneous improvement in all these fields. The production policy should be based on modernisation of agriculture in

which adoption of technology is by far is the most crucial input to make sustained high growth rate possible. A rapid rate of growth is necessary to impart the required stability to the economy.

2.3.3 Agricultural production pattern has to be diversified for ensuring availability of alternative foods including protective foods and raw materials, and for increasing employment and income. In order to reduce nutritional deficiencies much greater availability of animal protein should be planned for through livestock and poultry production and development of fisheries. Improving the nutritional conditions of the vulnerable population groups should be of special concern. A well conceived food and nutrition policy has to be laid down to improve health and labour efficiency. Production policy should be nutrition oriented. Norms of nutrition should be established for different population groups and different regions and production programmes should conform to these norms.

2.3.4 A continuing expansion and diversification in production will be necessary for creating surplus for export in raw or processed form and for import substitution since the continuity of economic progress requires a viable balance of payments situation. Increasing attention has to be paid on exploring export potential and identifying new commodities and non-traditional areas for stepping up exports, increasingly in processed form.

2.3.5 While growth *per se* is important, and continuous growth and expansion of the economy must be planned, the consideration of equity must be built into the growth oriented programmes. There should be a positive slant in the agricultural development policy towards involvement of the weaker sections and backward areas in the process of growth with a view to ultimately eradicating poverty. State assistance should be directed to help the weaker sections through promotional and productive programmes. It will be necessary to create infrastructure as well as special institutions for the benefit of these sections of population. The main emphasis should be on the creation of large scale opportunities for productive employment, for raising the income levels of the weaker sections of the rural society through diversification of agricultural activities, promotion of subsidiary occupations and development of secondary and tertiary sectors in the rural areas. Backward areas will need much greater attention for their accelerated development. Also, an important policy objective should be the reduction of rural urban disparity.

2.3.6 An important aspect of employment policy should be to take away the child labour from the employment market and prepare them through education and training for more fruitful participation in the development process when they come to age. For the adult

workers reasonable minimum wages would be essential to reduce the number of persons below the poverty line.

2.3.7 The maintenance of ecological balance should be an important objective. Greater accent has to be placed on using renewable forms of energy and maximising the use of nonrenewable forms. A rural fuel supply policy should be adopted to promote conservation and recycling of all organic waste. Considerable stress will have to be laid on programmes of research on environmental control. Wherever necessary, compulsion should be used to prevent loss or deterioration of the resource endowments.

Main Elements of Agricultural Policy

2.3.8 A reordering of the agrarian structure should receive a very high priority in the development strategy to lay the foundation. Keeping in view the main goals of policy, the land policy should ensure intensive utilisation of land, create widespread productive employment and reduce disparity. It should induce changes in property relations and social structure in rural India with a view to enabling wider involvement and participation in development. The undue concentration of ownership and in the use of land should be avoided through a rigorous implementation of ceilings on both ownership and operational holdings. However, the current ceiling limits should be deemed to have been laid down on a long term basis and should not be disturbed for a sufficiently long period to encourage investment in land and production. Also, there should be minimum time gap between legislative enactments and their implementation to avoid aberration so that there is sufficient stability to foster investment. The emphasis should be on personal cultivation to ensure adequate attention to land, and for increased productivity and production. The agrarian structure should be based on peasant proprietorship, strengthened and supplemented by cooperative and joint farm enterprises and backed by the necessary supplies and services for optimum utilisation of land. State assistance should be given, on a preferential basis, to the small cultivators who get together for joint farming. Leasing out should, however, be allowed by small owners within the size class of marginal farmers and in the case of exempted persons due to their special circumstances. In respect of others, all forms of tenancy and share cropping should be abolished and the tenants and sharecroppers vested with proprietary rights on a date to be specified by the State Government. Efforts should be made to detect all surplus land for distribution to the landless and marginal farmers, priority being given to the landless particularly Harijan, tribal and backward communities. In this process, caution is needed against distri-

duction of village common lands as part of the land distribution programme. Such lands should be preserved and utilised for the general good of the village community, particularly for the benefit of the weaker section. House sites should be provided to the landless who cannot be given land and they should be assisted to build homes and practise subsidiary occupations at the house sites.

2.3.9 The consolidation of fragments of land holdings into compact areas should be an important aspect of land policy for both operational economy and production benefits. The land holdings of small and marginal farmers and the land distributed to the landless should be consolidated in compact blocks to facilitate the concentration of public investments in irrigation and land development exclusively for the benefit of the weaker section. The creation of new fragments by transfer of a portion of land area by partition should be discouraged, and transfer by sale etc. should be permissible only to the cultivators of contiguous land. The land consolidation programme should be given very high priority in irrigated areas and command areas of irrigation projects. For optimum results, the programmes of land reforms, consolidation of fragments, land development, irrigation and drainage should be integrated and executed in proper sequence.

2.3.10 A primary concern of the land use policy should be to continuously increase the productive capability of land and to prevent its deterioration. Soil being the most important medium of plant growth, its management and improvement must permeate the policy of land use, soil conservation being looked at as integral part of programmes for maximising land use.

2.3.11 The use of land should be optimised by putting it to the best use as is consistent with ecology and the capability of the land, and is justified by economic returns. Good agricultural land should not ordinarily be diverted to other uses, such as, village *abadi*, factories, etc. For improving the environment and for meeting man's economic needs, it is essential that land use planning is based on a resource survey and production potentiality of the land. The cropping pattern should be restructured to suit the agroclimatic conditions, and the crops shifted from low yield environment to high yield environment to obtain the maximum return from land. However, crop planning should be based not only on the agroclimatic factors but also on considerations of supply-demand balance. The restructuring of the cropping patterns has to be supported by a public food distribution machinery as a national policy.

2.3.12 Diversification in land use should be encouraged by introducing in the cropping patterns, crops like pulses, oilseeds and

fodder, particularly in low rainfall areas. Since the arable land area is limited, suitable land augmenting technology has to be developed, which would enable intensive use of the land resource. Double and multiple cropping, wherever possible, should be encouraged. Although the scope for supplementing land by extension of area is limited, land reclamation and development should be undertaken wherever there is scope.

2.3.13 For diversifying production, increasing return from land, employment and income and ensuring a balanced supply of food and fodder, the farmer should be encouraged to take to mixed farming, dovetailing cultivation with subsidiary occupations like the raising of livestock and poultry, rearing of fish, silk work and bee keeping, etc. This would ensure year-round use of resources and labour potential of the farm family and the livestock.

2.3.14 Crop development should be designed to secure early increase in the production of those commodities which are in short supply. The long term policy should be to restructure the cropping patterns based on rain fall and soil conditions and evolve and apply technologies to secure substantial increases in yields as well as to bring about a balance between supply and demand. There should be an all India approach in this regard, and it is not necessary for each State to be self-sufficient in all agricultural commodities. A major effort has to be made to encourage the cultivation of crops not only at appropriate places but also at appropriate times and with proper agronomic practices with the required backing of inputs and services. The area under fruits, vegetable, fibres and fodder should be increased in future in response to the growing demand. Apart from production increase, the quality has to be improved. Considerable emphasis has to be placed on research towards breeding of varieties for earliness, drought resistance or flood tolerance, resistance to pests and diseases, etc.

2.3.15 The animal husbandry development policy should be based on the application of science and technology to animal production. Its objective should be diversification of the agricultural production base, improvement of human nutrition, provision of supplementary income to the weaker sections of the rural community and increasing the employment potential. The essential elements of the strategy should be to improve the productive potential of livestock and poultry including draught power of cattle, arrange for provision of feeds and fodders only for the productive stock and weed out inferior uneconomic and surplus animals. Improved husbandry practices and better health cover should form important components of this strategy.

2.3.16 For improving the productivity of cattle and buffaloes,

the policy should be to adopt scientific methods of breeding, to provide adequate feeds and fodders and animal health cover and to improve management practices. A close tie up between intensive cattle and buffalo development programmes and dairy plants will be necessary for providing a ready market for the milk producers and ensuring remunerative prices. With a view to effecting progressive improvement in the milk yield, a considerable proportion of the existing population of low yielding cows and buffaloes should be replaced with crossbred cows and improved species of indigenous cows and buffaloes. In the milk production enhancement programme, the approach should be to identify suitable areas and to undertake integrated cattle and buffalo development-cum-milk marketing projects.

2.3.17 The best policy for the development of dairying, suiting Indian conditions, would be to produce milk in the rural areas for supply to the urban consuming centres. Small and marginal farmers and landless labourers should be associated with the milk production programmes. Collection, processing and distribution of milk and manufacture of milk products should be organised, as far as possible, through cooperatives of milk producers themselves. The development of dairying should be effectively interwoven with the economy of the villages. A national milk grid with conservation facilities should be developed to even out seasonal and regional imbalances and to reduce rural urban inequalities in milk consumption. The new policy should aim at self-sufficiency in milk and milk products thereby increasing the capability of export of finished and sophisticated products.

2.3.18 Sheep population should be multiplied at a faster rate. Large scale crossbreeding programmes by using exotic breeds of sheep should be undertaken for rapid increase in wool and mutton production. Greater part of the arid regions should be utilised for range land and pasture development. The natural pastures in northern temperate regions should be improved. Leguminous fodders should be included in the cropping pattern in irrigated areas, and large blocks of government range lands should be developed, mainly as grass reserves.

2.3.19 Marketing of wool and live animals in major sheep rearing tracts should be organised through sheep farmers' cooperatives and wool boards, which should take up the responsibility of sheep shearing, wool grading and storage. Marketing yards should be set up for sale of live animals. A policy for realising higher trade balance in respect of wool and woollens should be followed. Its main features should be : (a) progressive restrictions on export of raw wool; (b) encouragement to export of manufactured woollen goods;

(c) close linkage of wool production and manufacture of woollen goods and woollen carpets with the schemes of handicrafts boards/khadi boards functioning in the area; and (d) simplification of the procedure of payments of drawback claims of duty on woollen goods for export.

2.3.20 Since goats cause considerable damage to natural vegetation, their number should be reduced to a manageable limit, and stabilised. It is necessary to devise suitable management systems to exercise greater control over their movement and feeding habits. Goats should be kept out where soil conservation practices are being introduced. Lopping of trees for feeding of goats should be avoided and stall feeding of milch goats encouraged. The approach for raising meat production from goats should be selective breeding among taller and medium sized breeds and outcrossing nondescript types with select meaty type bucks. Crossbreeding with exotic dairy breeds of goats should be undertaken for increasing milk production. Milk capabilities of better indigenous dairy breeds should be improved through selective breeding.

2.3.21 The genetic make up of the indigenous pigs should be gradually changed by introducing exotic breeds of boars. For organising production, pig producers' cooperatives should be formed and supply of quality pigs and balanced feed, as well as adequate health cover and marketing facilities should be ensured as a package. Intensive pig rearing areas should be developed around the bacon factories and pork processing plants. The bacon factories should adopt a pricing policy for pork and pork products favourable to the producers to give encouragement to pig production.

2.3.22 Poultry development should aim at self-sufficiency in production of quality chicks and increased production of eggs and poultry meat. This could be achieved through adequate supply of poultry feed at a reasonable price and its quality control, proper marketing of poultry produce and adoption of appropriate breeding strategy. In areas where high standard of poultry husbandry exists, high producing strain/cross or incross hybrid chicks should be made available. For poultry farms in the intermediate stage of development, crossbred birds would be preferable. In the rural areas where backyard poultry rearing practices are in vogue, the most practical breeding programme would be to grade up the local stock with improved exotic varieties. The crossbred males should be reared under semi-intensive or free range system so that they are not at a disadvantage, when distributed in the villages. All indigenous cocks and cockerels should be replaced by crossbred males. Early action should be taken for licensing all commercial hatcheries to avoid disease.

hazards. Producers' cooperatives should be organised for providing necessary inputs as a package to the poultry farmers.

2.3.23 An effective veterinary service should be developed to keep livestock free from hazards of animal diseases to ensure optimum production. For achieving this, the funds of the Veterinary Departments will have to be supplemented. A phased programme of levying a charge for the treatment of livestock, including prophylactic vaccinations should therefore be introduced immediately. Private veterinary practice should be encouraged by providing suitable incentives to veterinarians to augment the efforts of the Government veterinarians in protecting the health of livestock. Biological production centres should be converted into corporations for giving them a certain degree of autonomy so that these could function with some freedom from the usual restrictions of government rules and regulations.

2.3.24 Modernisation of slaughter houses, should be regarded as a development activity and not as a commercial venture. There is considerable scope for building up an export market for buffalo meat especially to the countries in the Middle East. For achieving this objective, the meat characteristics of the buffalo should be improved. The export of meat and meat products should be brought under the control of some organised agency and the quality control ensured. An organised marketing service for meat animals should be established in the cooperative sector.

2.3.25 The overall policy should be to encourage dispersed development, each area specialising in the development of the livestock and poultry which suit the environment. Each area must have a programme of increasing feed and fodder resources. Wherever necessary, controlled and rotational grazing should be adopted to allow for adequate regeneration of the grasses.

2.3.26 Development of inland fisheries should be undertaken as a priority industry to increase the availability of low cost animal protein. As Indian carps remain the mainstay of culture in freshwater, their seedfish supplies have to be increased several fold for undertaking increased stocking densities to obtain optimum yield from all culturable waters. A major aim should be to make optimum use of water resources like ponds and tanks for fish production. For encouraging fisheries development, greater attention should be paid to the requirements of small fishermen. Since water bodies are indivisible, small-fishermen should be encouraged to form cooperatives for fishery development. Rights in culturable fisheries should be granted as outright leases on reasonable terms to enable utilisation of long term credit. Similar procedure should be adopted for waters under Gov-

ernment control. Since a large number of tanks and ponds are unutilised because of private ownership rights, the State Governments should take control of such water areas and utilise them for pisciculture. In regard to reservoirs in irrigation projects, the interest of fisheries should be kept in view right from the planning stage.

2.3.27 Marine fishery policy should be recast in the light of an exclusive fishery zone adjoining the coast. The accent on distant water fishing fleet should be replaced by more concentrated effort for the exploitation of the seas within 320 Km of the Indian coast with emphasis on small and medium sized trawlers. The inshore fisheries areas and coastal creeks should be developed for higher yields through mariculture of prawns, molluscs and suitable coastal fishes. In marine fisheries also, the small fishermen should be given preferential facilities in terms of fishing boats and gears and landing facilities. It will be essential to take necessary measures for delimitation of fishing zones through legislation in order to avoid conflicts amongst the non-mechanised crafts and mechanised boats and larger fishing vessels and between fishermen of adjoining States. Uptodate information on marine fish stocks should be built up through comprehensive research. Oceanographic research will have to be intensified so as to develop fully the strategy to utilise the extended resources of pelagic fisheries beyond the traditional zone of exploitation of coastal regions particularly in the west.

2.3.28 Fishery development should invariably be accompanied by arrangements for storage so that the fishermen are not required to dispose of the catch at throw-away prices. Infrastructural facilities, like fishery harbours should be developed to support marine fishery development. In order to utilise fully the resources in the deep waters, infrastructural facilities should be provided in the public sector, which could then give the lead to the industry as a whole. A policy of developing specialisation in fishing boat building by a few yards should be fostered.

2.3.29 Special attention should be paid to crustacean fisheries, which have great export potential by way of comprehensive survey of the resources, regular monitoring of the status of the fisheries and diversification of : (a) production and processing centres, (b) export products; and (c) export markets. In this sector, small entrepreneurs as well as large business houses need to be encouraged as scope exists for both.

2.3.30 All aspects of fisheries activities, and ancillary industries based on them need to be brought under uniform control. As the Indian Fisheries Act of 1987 is outdated, a new fisheries act should be enacted to cover all these aspects on an all India basis to confer

enabling powers to the State Governments, particularly in respect of prawn fisheries and others showing signs of depletion.

2.3.31 In view of the increasing demand for forest based products, there is need for greater attention to increase the productivity of forests and their scientific management on modern lines. The national forest policy should rest on two pivotal points, namely, meeting the requirement of raw materials for forest based industry and small timber, fuelwood and fodder for the rural community, and satisfying the present and future demand for protective and recreative functions of the forests. All the requirements must be met in full and self-sufficiency achieved as early as possible. There should be not only a dynamic production forestry but also an extensive social forestry programme. Forests must have adequate share of land and no deforestation should be permitted without the approval of the State Legislatures. Since interdependence between forestry and forest industries sectors is vital, integrated planning for raw material production and forest based industry would have to be a major aim of future policy. The required institutional changes should be made and infrastructure built up for the purpose. The price of the forest produce for the industries should be so fixed as to pay for the cost of clearfelling and plantations and maintenance of production forests, and leave a profit. Possibilities should be explored for cultivating plantation crops like rubber, coffee, cashew, etc., in suitable localities on forest land to the extent that they do not interfere with the production of industrial wood.

2.3.32 The domestic needs of the people living near forest areas for small timber, fuelwood and fodder are primarily to be met from forests mainly through widespread adoption of social forestry programmes, which would lessen the burden on production forestry. Since free supply of forest produce to the rural population and their rights and privileges have brought destruction to the forests, forest produce for the rural population should be priced reasonably.

2.3.33 Forestry programmes should encourage wildlife development and environmental balance. Some areas, carefully selected and distributed as to embrace varied natural conditions and ecosystems, should be devoted to the principal use of Nature and wildlife conservation.

2.3.34 Existing legislation on forestry should be strengthened, and for the sake of uniformity and concerted action for forest development, a revised all India Forest Act should be enacted. The national forest policy should be recast as explained later in Chapter 9 on Forestry keeping in view the requirements of forestry in future years.

2.3.35 Agricultural production based on modern technology requires all round institutional and infrastructural support. Integrated planning for the provision of the supporting services will be essential. Since the absence or inadequacy of any element is likely to impinge on the realisation of the full yield potential of modern technology the basic policy should be to offer support in a package consisting of inputs, credit, marketing etc. The institution of custom service should be firmly established so that inputs and technical advice, wherever necessary, are made available in time to the farmers. In providing support in terms of water, fertilisers, credit, marketing etc., special efforts and arrangements will have to be made for enabling small and marginal farmers to avail of them. The investment decisions of the State should be guided by such preferential considerations. This may imply the creation of infrastructure and institutions specially for this section of the farming population.

2.3.36 An area approach is required to be brought to bear on the development of infrastructural facilities. Irrigation development, command area development, soil and moisture conservation, milk production programme, etc. are examples which give best returns when developed on an area basis. In building up these facilities on an area basis, there should be built in provision for special assistance and attention to the weaker sections.

2.3.37 Wherever possible, community approach to the use of inputs should be encouraged. Community use of scarce groundwater, plant protection on area basis involving groups of farmers are instances which bring about better economy in the use of resources and a greater measure of social justice.

2.3.38 In view of their insufficiency to meet the irrigation requirements in the country, the available water resources should be utilised with great efficiency and economy. Comprehensive river basin plans should be drawn up for the proper development of the land and water resources of the basins. Wherever feasible, surplus water in a river, such as in the Brahmaputra, the Ganga and the west flowing rivers south of the Tapti should be utilised in other basins, where there is paucity of water. In drought areas, where there are precarious water resources, surplus water should be brought in even at a sacrifice from other basins, which have better water resources. For this purpose and for better utilisation of surplus water in a river, there should be legal provision for the interbasin transfer of water by making the necessary constitutional amendments.

2.3.39 Irrigation policies should aim at :

- (i) maximum production per unit of area through multicropping in areas with ample water resources;

- (ii) maximum production per unit of water in region of medium and low rainfall in which a large part of the country lies;
- (iii) protection of maximum area possible in drought areas;
- (iv) irrigation of maximum area during the rainy season by supplementing rain;
- (v) maximum utilisation of irrigation supplies from storage during eight months of the year excluding summer when evaporation losses are the highest; and
- (vi) conjunctive use of surface water and groundwater.

2.3.40 Investigations of an irrigation project should be comprehensive and should cover not only engineering works but also command area development for utilising the irrigation supplies. It is obvious that unless the development of command area is also completed, full benefits cannot accrue from the project. All steps necessary for the development of land in a command area should be taken together in an integrated manner. Consolidation of land holdings is an indispensable step if land formation is to be done properly. Within the command of a new outlet, the smaller holdings should generally be located at the beginning of the watercourse and the larger ones further away to facilitate equitable distribution of water to the small holdings.

2.3.41 Because of the high cost involved in their construction and the equipment and skill required for them, deep tubewells for groundwater development are best undertaken by the public sector. All other groundwater development should preferably be in the private sector. Jointly owned private tubewells, being more economical than individual wells, should be encouraged. The pre-emption of groundwater by individual farmers by sinking individual wells should be discouraged and if a farmer constructs a private tubewell which yields more water than what the size of his holding justifies, it should be permissible for the farmers having contiguous holdings to avail of their share of tubewell water on payment of share cost. In areas where groundwater is getting overexploited, the State must intervene and rationalise the extraction and distribution of water, through appropriate legislation.

2.3.42 Adequate water charges should be levied on the beneficiaries. In fixing irrigation rates, the overall consideration should be that, taken as a whole, the irrigation works in a State should not impose any burden on the General Revenues.

2.3.43 Crop improvement programmes have to be adequately supported by the supply of good seed material. The basic policy will be to evolve suitable varieties of various crops and to produce en-

ough quantity of seeds for extensive use. Simultaneously, production and sale of substandard seed material which affect yield and undermine confidence of the farmers, have to be firmly controlled. For proper development of the seed industry, there should be division of responsibility among the research institutes, agricultural universities, National Seeds Corporation, State farms, Government departments and private seed growing agencies in the matter of multiplication and distribution of seed. Seed industry should be made an attractive enterprise to encourage production of adequate quantities for consumption and export, thereby opening up new avenues of employment and income. Small seed growers should be encouraged to form compact areas for seed production where State assistance can be directed with greater ease and more effectively. The seed business should be made competitive by throwing the business open to both public sector and private agencies. In encouraging multiplication and distribution of seed, particular care will be necessary for ensuring quality through appropriate investigation and control arrangement.

2.3.44 Efficient and balanced use of fertilisers and combined use of organic manures and fertilisers will be essential for obtaining maximum potential yield and for the success of farming based on modern technology. The use of fertilisers should be governed by the principle of optimising rather than maximising the dosage to enable extensive use at a lower dose to cover larger farming areas. Special attention will be needed to overcome micro-nutrient deficiencies by developing suitable methods for incorporating them. There should be greater application of organic matters and wastes in order to permanently improve the physical and biological conditions of the soil for which recycling of processed waste in all available forms is a matter of urgent necessity. The production of chemical fertilisers has to be substantially stepped up to meet the progressively larger demand as modern crop production technology is adopted on wider scale. It will be necessary to plan for self-sufficiency in fertilisers since availability from international sources is often uncertain. Attempts should be made, as soon as possible, to change over to indigenously available raw materials in the manufacture of fertilisers. For meeting the requirements of high analysis fertilisers, straight/complex/compound, the fertiliser industry should try to develop appropriate technology so that fertilisers of higher efficiency could be made available to the farmers at a low cost. The distribution policy should include an aggressive promotional drive and seek to make fertilisers available in sufficient quantity even in the interior areas. The promotional measures should stress the use of balanced fertilisers. The distribution network should envisage stocking of fertilisers at intermediate points

for quick transit and timely supply to consuming areas so that transport bottlenecks faced in supplies from factories to field are avoided. Strict quality control should be an important aspect of fertiliser policy.

2.3.45 Reducing crop losses should be an important objective of development. A policy of integrated pest control has to be adopted. This will include evolution of pest and disease resistant varieties, treatment of seed before sowing, prophylactic and curative spraying during the crop season, biological control and control of pests through agronomic practices. For optimum results, the adoption of pest control operation on area basis is essential and should be made compulsory with provisions to recover proportionate costs from the beneficiaries. In the choice of chemicals, those with greater risk of pollution should be discouraged. An important aspect will relate to the education of the farmers regarding proper use of pesticides.

2.3.46 In the labour abundant situation in the country, the basic approach should be to meet the farm power needs by utilising, as a first priority, the available manpower and draught animals. Implements should be improved and used to gain better efficiency in man and animal power, and to enable precise farming. The use of agricultural machinery should be on highly selective basis and may be allowed to bridge the power gap in areas which exhibit a market shortage of both man and animal power. In labour surplus areas, suitable control will have to be exercised to see that mechanisation is not resorted to for avoiding labour management problems and does not depress wage levels. In the course of agricultural development, the use of machinery should be so regulated as to facilitate continuous progress towards full employment. In certain non-repetitive land development work, mechanical support will be justified for undertaking heavy work and expediting development, which will result in larger and sustained employment. Similarly, mechanical and electrical support is also justified in irrigation.

2.3.47 Electricity should be made available for energising pumpsets and for rural industries in practically all the villages by 1990. Supply of electricity for agricultural operations should be made on priority basis, and uninterrupted and unfluctuating supply ensured. Special consideration should be given to the extension of electricity to fishermen colonies along the seacoast.

2.3.48 The credit policy should be designed to provide an integrated agricultural credit service so as to facilitate the adoption of new technology, to extend its scope to cover all aspects of rural development including production, marketing, transport and processing, and to facilitate and provide linkages between finances and services for current inputs as well as investment in land improvement,

minor irrigation and farm equipment. The guiding principle should be to finance individual enterprises or projects, which have actual or potential financial viability. The institutional and public resources used for such development must generate, over an identified period, adequate flow of income for the repayment of loan.

2.3.49 Considering the overall constraint of credit, due weightage will have to be given to the small and marginal farmers and agricultural labourers and rural artisans in respect of quantum of credit and interest rates. An important aspect of credit policy should be to help the farmers to reach self-sustaining stage through the principle of graduation which would make them plough back their surpluses into agriculture increasingly. In providing credit to medium and large farmers their capacity to provide own funds should be kept in view.

2.3.50 For upgrading and modernising agriculture and efficient utilisation of credit by the weaker sections, an integrated and supervised credit structure will have to be built. This structure would consist of farmers' service societies (FSS) at the grass-root level, controlled by the small and marginal farmers and agricultural labourers, which would be linked to a commercial bank or a co-operative central bank for necessary financial and managerial support. The FSSs should also encourage and finance viable units of suppliers of inputs, custom services, storage and transportation and marketing in their respective areas. All types of credit should flow through the single agency to ensure appropriate control and use. Increasing use of institutional sources should be made to find resources for large scale area development programmes like command area development.

2.3.51 To ensure reasonable returns to the producer and availability of the goods at reasonable cost to the consumer, an efficient marketing structure has to be developed. In general, the farmers should get the marketing facilities within a radius of 5 Km from the place of production. The existing weekly markets should be developed into assembling or submarkets. New markets should be organised in areas brought under irrigation and areas of intensive production. The bigger markets should be regulated on a priority basis, and the necessary amenities provided therein. All the agricultural commodities which enter trade should be graded, and those entering export trade should be compulsorily graded and inspected. To ensure high quality of the processed products, improved processing facilities should be made available at places near about the centres of production. These processing and marketing activities should be organised, as far as possible on cooperative basis, the primary cooperative marketing societies being linked with the commodity corporations such as those for food, cotton and jute.

2.3.52 The scientific agricultural policy will consist of among others, an integrated approach to research, education, extension and training for all-round agricultural development. The policy will be to create strong base for fundamental and applied research in universities on the principle of integrated teaching, research and extension education, demarcate the functions and responsibilities of agricultural universities and State departments *vis-a-vis* teaching, research and extension, develop appropriate staffing pattern of technical personnel keeping in view the responsibilities and functions and train technical and administrative personnel of the departments as well as farmers. For the agricultural universities to be able to conduct applied research, regional research stations may be placed at their disposal at the rate of at least one per agroclimatic region. Central institutes should concentrate on research and not award degrees as this would defeat the very objectives of the institutes. Now that agricultural universities have been set up in good number, the training courses in research should be centred in the universities only.

2.3.53 The involvement of the scientists in the universities for extension on the farmer's field in the nature of demonstration and intensive programmes should be limited. Every scientist in the university, having a good research base should have direct contact with the field so as to get first-hand knowledge of farmers' problems by placing highly trained extension subject-matter specialists in the respective divisions at the headquarters and each of the regional research stations. For this purpose, each teaching department should be converted into a division with such integrated functions. For adaptive research by the State departments, experimental farms, which are usually meant for demonstration work and raising seed etc. should be placed exclusively under the control of such Government departments. These departments must have in their cadre qualified scientists to do adaptive research. The State departments shall be made fully responsible for the entire field of extension functions in the States except for the limited involvement of research scientists to the extent indicated above. The programme, subject-matter and extension specialists at the State level shall maintain contacts with the specialists in the university division. At district and tehsil or taluk level, there should be a team of specialists in appropriate fields. To provide support to Village Level Workers, five to six graduate extension officers should be provided in each block. In animal husbandry, there should be a graduate field extension officer at least at taluk level. In the district where special programmes are being undertaken in animal husbandry or fisheries, additional suitably qualified extension officers should be posted.

2.3.54 Considerable emphasis should be laid on national demonstration programmes for conveying research results to the farmers. There has to be greater emphasis on the pre-university and nondegree institutional programmes in agricultural education. Considerable stress should be laid on functional literacy-cum-education campaign for developing decision making ability among the farmers. Farmers' education and training programmes should include the education of women in the rural areas also through a special curriculum, which should emphasise the more technical aspects of subsidiary occupations, diet patterns, nutrition as well as population education. Training and involvement of the youth in the agricultural development will be an important policy objective.

2.3.55 The agricultural price policy should keep in view its impact on the general price situation and on the economy as a whole. It should be in consonance with the country's overall economic policy and facilitate growth with stability. The major aim of agricultural price policy should be to correct distortions which are in general socially or economically harmful and which emerge from time to time because of the imperfections of the market mechanism. Being parts of the same policy, the interests of the producers should be safeguarded through price support operations when there is a sharp fall in prices, and the interests of the consumers, particularly the vulnerable sections of the population, should be protected through procurement and distribution of a part of the marketable surplus at below the market price when there is a sharp rise in prices of basic necessities, such as cereals.

2.3.56 Reliance should not be placed on prices as a principal mechanism for augmenting production in a situation where there are overall shortages. Since such a policy adds to price rise without yielding higher production, the increases in output and the farmer's income will have to be brought about mainly through technological improvements and availability of crucial inputs rather than by manipulation of prices. However, for encouraging investment in agriculture and for adoption of modern technology the assurance of a remunerative price to the farmer will be essential. A policy of offering minimum support prices for the principal crops must be followed. The minimum support price should be fair to the farmer, and should cover his cost of production and leave him a reasonable margin of profit. Price fixation should take into account the variations in the prices of inputs, and the output prices should not generally be out of alignment for long with the package of input prices. The overall relationship between input and output prices within agriculture and the terms of trade between agriculture and other sectors of the eco-

nomy should be such as to stimulate growth in rural areas.

2.3.57 Since the minimum support price is expected to take into account changes in input prices, widespread use of input subsidy as incentive to increase production should, by and large, be avoided except in the case of small and marginal farmers and difficult areas. In the latter case, a transport subsidy will be in order. However, for promotional efforts in specific cases timebound and tapering input subsidy will be justified. The minimum support prices should be fixed uniformly for the country. For special high cost areas, however, a differential price may be allowed but the difference should be limited to the cost of transport from the nearest area producing the same crop where the uniform price is applicable. In order to provide support to the farmers, commodity corporations and buying agencies should make purchases not only from the established markets but also from interior markets and producing areas as soon as the marketing season for a particular crop starts, as this measure will particularly help the small growers. When prices tend to be low following a bumper crop, it is necessary for the purchasing agencies to make support purchases of surplus production in excess of the minimum demand and build a buffer stock which can be used to stabilise prices in lean years and for export. Adequate arrangements are also necessary for promotional purchase of new commodities in order to establish the cultivation of a new crop widely.

2.3.58 Public distribution of essential commodities will have to be a permanent or a semi-permanent feature of economic management in the country in the context of shortages. In such a situation, procurement prices of cereals have to be below the prevailing market prices in order to subserve the needs of the public distribution system. Since the issue price has to be related to the purchasing capacity of consumers with low income, the procurement prices, although higher than the minimum support prices, cannot be much above the issue prices minus the cost of distribution plus, at best, a small element of subsidy. In respect of commercial crops, the prices at which the commodity corporations and other agencies are to buy the crops should be determined after taking into account their impact on the domestic industry, the economy and exports. The principle of price support should be extended to livestock and poultry, fishery and forest products.

2.3.59 As a general principle, no subsidy should be given for agricultural developmental programmes, including distribution of inputs except to the weaker sections of the society and in difficult areas. An integrated framework of policy for subsidy should be based upon the principles of selective application and subvention for

those classes, sectors and key programmes that need support in the interest of balanced and rapid development, and in keeping with the objective of growth with social justice. The possibility of introducing a system of crop insurance and insurance of capital assets to minimise the risk of the farmers need to be examined in detail and suitable arrangements made for its introduction. The policy of social and community recognition to innovating and enterprising farmers, who have distinguished themselves by achieving greater productivity, needs to be continued and its coverage enlarged.

2.3.60 For securing greater involvement of the farming community in agricultural development, a well knit, strong and competent organisation of farmers with units from the grass-root to national levels, will require to be built up. The main task of this organisation would be, on the one hand, to motivate, educate and assist the farmers in scientific farming and in achieving the objectives and targets of various development programmes and, on the other, to apprise the Government of the problems of development and assist it in devising appropriate remedies and thereby safeguard the interests of the rural community and foster its growth. Adequate representation of the interests of the weaker sections and women on this organisation will be necessary.

2.3.61 Agriculture being a State subject, the major responsibility for agricultural development will be that of the State. However, Central role and leadership is and will continue to be important in certain areas of all India importance like provision of food for the country. Central initiative will be necessary to forge a national consensus and broad pattern of agricultural development. The Centre would have to take a number of developmental measures and create institutions which support State initiative and help in the effective execution of programmes by the States. Similarly, the Centre may have to legislate for the country as a whole with the consent of the States where a uniform policy has to be pursued throughout the country. Alternatively, it may have to make skeletal legislation to set the pattern for the country and guide the States. The Centre-State relations in the matter of agricultural development should be based on consultations, consensus, cooperation and complementarily to foster the discipline of national agricultural development, expand the area of mutual commitment and collaboration and ensure harmonious growth through both national and local initiative. These are discussed in the next section.

2.3.62 There are several aspects of agricultural development which may need compulsion in the interest of common good. For example, consolidation of holdings soil conservation, land development, drainage, plant protection programmes, have to be organised

on area basis. If a majority of the beneficiaries agree, there should be provision making the participation of others obligatory and for undertaking the operations and realising the cost from all the beneficiaries. Further, in regard to fertilisers and pesticides, quality control is important. Improved seeds need certification guaranteeing purity and germination. Food products need to be certified as hygienic from the health standard. For these also, appropriate legislation will be necessary. While, in general, regulation of crop acreages through legislation may not be practicable under Indian conditions, in some cases notifying certain areas for growing certain varieties of the crop, as in the case of cotton, and for prohibiting the cultivation of certain crops like tobacco in certain areas or potato in areas which are prone to diseases, may become necessary in the interests of agricultural production. Land reforms, minimum wages, restrictions on movement are other spheres in which legislation is necessary. In all these cases, it is desirable to have a certain amount of uniformity subject to local adaptation and modifications.

2.3.63 The Centre has to take upon itself the specific responsibility of ensuring all India priorities for the lowest level of rural households and the small and marginal farmers. For creating adequate opportunities of employment and income for this section of the rural population, an all India strategy of expediting the growth not only in crop production but also in livestock and poultry production, fisheries and forestry would be needed. Considering their importance, these programmes have all India importance for which the Centre has to take a large measure of responsibility to formulate the appropriate policies and guide the States in executing the programmes.

2.3.64 The administrative structure in the developing field of agriculture must be in a position to meet the requirements of the people as pressures of scientific agriculture develop, and be capable of supporting the rapid but orderly movement towards modernised agriculture. The structure should be based on a single line of control from the State to the village level and technocrat oriented with emphasis on improving the technical competence of the administration and decentralisation of decision making responsibility and strengthening of field level organisations. An Indian Agricultural Service should be formed on an all India basis to lay the foundations of a strong agricultural administration in the country, to facilitate exchange of expertise and experience and to provide career opportunities in an organised service with adequate prestige and status. The administrative structure should also facilitate the planning of agricultural programmes from below with district as the primary planning unit. Furthermore, administrative arrangements should be strength-

thened for the formulation and execution of a comprehensive programme of education and training exclusively for rural women and children.

Strategy

2.3.65 The main elements of policy, as described above, are designed to promote growth, stability and social justice and result in a continuous improvement in output, employment and income. These have to be seen in their totality because of their interdependence, so that the implementation of these policies leads to coordinated development of the entire agricultural sector and make optimum utilisation of available resources possible. The agricultural sector would then grow at a rate sufficient to sustain a high rate of growth of economy as a whole.

2.3.66 While the strategies needed for integrated rapid and sustained growth and development in different fields of agriculture as well as the distribution of the benefits to the various sections of the community have been spelt out in detail in the respective chapters, the overall strategy for enhancing agricultural production should consist of the following important elements :

- (i) land and land use policy which improves growth prospects;
- (ii) continuous improvement in yields;
- (iii) increased availability and efficient use of scientific inputs and credit;
- (iv) adequate support by research, education and extension for (ii) and (iii) above;
- (v) simultaneous attention to the needs and potential of growth in areas with different levels of development; and
- (vi) marketing and pricing structure which sustains this growth.

2.3.67 The various segments of the policy are inter-related. The apparent conflicts among objectives and priorities in respect of various elements of the policy can be resolved by having a judicious mix of policies.

2.3.68 The acceptance of the policy of growth with social justice implies that the requisite institutional structure should be developed so that resources are provided to the weaker sections of the population and necessary safeguards are built in to protect their interests in the structure so evolved. The pattern of investment should be such as would diversify and expand rural employment and income and reduce widening regional disparities.

2.3.69 In the Report, both short term and long term proposals

for development have been made. The instruments of policy adopted in a shorter run situation should not be completely at variance with those for attaining long term goals. While there is need for flexibility and continuous adjustments based on periodic review, too frequent and drastic changes in the policy structure will not be desirable.

2.3.70 In a world of fast changing technology, there are many imponderables associated with the dynamics of development. Taking note of the numerous variables, which affect demand and supply conditions, the policies and strategies recommended in the Report may have to be periodically adjusted to facilitate rapid growth and desirable social changes in accordance with the needs and possibilities.

4 CENTRE STATE RELATIONS IN AGRICULTURAL DEVELOPMENT

2.4.1 A national plan for agricultural development, based upon science and technology and aiming at optimum growth with social justice, has to utilise the production potentialities and the investment resources irrespective of the State boundaries and the formal distribution of powers and responsibilities between the Centre and the State. The complexities associated with the formulation and implementation of such a plan under a federal set up have made a viable Centre-State relationship increasingly important.

2.4.2 While the responsibility for actual execution of agricultural development programmes must be that of the States, effective execution is dependent upon a chain of developmental activities in which the Centre has a vital role to play. Rapid modernisation of agriculture calls for continuous support of wide range of developmental activities including institutional and organisational innovations in which the Central Government and the national Institutions may be required to play a pioneering role.

2.4.3 While the Centre has a responsibility in areas like food management and production and distribution of scarce inputs flowing from centralised units or institutions for their optimum utilisation, Central participation and initiative are essential in areas like the development of an integrated national research system, inter-State or indivisible projects and innovative programmes considered risky by the States or due to the fact that the technical, financial, institutional and administrative resources of the States are limited. Also a national approach and Central participation and support are necessary to ensure standardisation and uniformity of approach or effectively tackle regional and group disparities.

2.4.4 The study of Centre-State relations has to transcend the programmes and operations directly undertaken by the Centre or those

included in the Central sector, as these occupy a minor place. A vast area under the State jurisdiction is left to the 'leadership' and 'influence' functions of the Centre. It is natural that the process of modernisation should be associated with the expansion of the areas of mutual commitment and collaboration to encourage the growth of both national and local initiative. Further, in the process of development, there has to be a national discipline and commitment in regard to the sharing of agricultural surplus, especially food, in the context of the adoption of scientific cropping pattern or regional specialisation.

2.4.5 There cannot be any fixed formula to demarcate the powers and responsibilities of the Central and State Governments in agricultural development. The norms for Centre-State relations should be developed in a long term perspective laying down only the broad framework and the basic principles which may allow the powers and responsibilities to be equated at each level in keeping with the changing demands of development.

Constitutional Position

2.4.6 The Constitution of India (1950) lays down the distribution of legislative powers between the Centre and the States in regard to agricultural development. While agriculture including animal husbandry, forestry and fisheries is a State subject, the entries in the Union List relating to formation of trading corporations, inter-State corporations, production and marketing of certain agricultural commodities, etc. cover a wide area of Central activities in the field of agricultural development, although entries directly related to agriculture are very few. But it is primarily from the Concurrent List that the Centre derives its powers to intervene in the field of agricultural development. It has enabled Central action relating to planning, production and regulation of supplies of foodstuffs and other selected agricultural commodities, price control and the like.

2.4.7 Taking an overall view, the Constitution offers adequate scope for the Central initiative touching upon almost every aspect of agricultural development. The issue is not as to which provision of the Constitution has been used for supporting Central initiative or action in one or the other form, not even if the particular provisions have been interpreted more liberally to serve particular purposes. The efforts towards modernisation of agriculture involve a measure of Central initiative which could not be visualised at the time of framing the Constitution. That this has taken place within the framework of the Constitution and without any legal disputes only proves that the flexibility of the Indian federal setup could keep pace with the growing

urges of development. From the point of view of agricultural development, what is more important is the increasing interdependence of Central and State interests and the realisation that there is hardly any problem of agricultural development that can be solved without mutual cooperation and commitment between the Centre and the States. Therefore, problems of Centre State relations in agricultural development, in our view, are basically not due to any gaps in the constitutional framework and have to be tackled not through any realignment of the legal positions but mainly through consensus and better organisation and management.

Planning and Policy Formulation

2.4.8 The broad outlines of national agricultural development plan and the disciplines of national agricultural development having been accepted by the States and the Centre after due discussions, a structure based on the broad division of responsibility between them for the implementation of the agreed programmes is necessary. The details of this structure have been worked out in Chapter 14 on Planning, Administration and Statistics. However, since the basic competence and capacity has not developed uniformly in all the areas in the country, the Centre, which has built up a competence in planning and technological expertise, may have to directly provide planning and Technological support in such areas than what the broad division of functions postulates.

2.4.9 For harnessing the national potential to the best effect, a continuous appraisal of both the changing needs and the available opportunity will have to be undertaken by the planning units recommended in Chapter 14. The chain of such units from the district to the national level will have to be the channel for discussions leading to the development of consensus for adjustment of the policy frame from time to time. Even after the formation of planning units in the States and the Centre, the instrument of working groups for the preparation of five-year plans and annual plan discussions will continue to be necessary for arriving at the consensus.

2.4.10 The main difficulty in formulating a national plan for a discipline by a working group at the State level and in the Central working group is the inability to tie up, at the stage of planning, the financial frame for the exercise. Considering the difficulty of forecasting the financial position, there should be a continuous dialogue between the State and the Central working groups till the finalisation of the plan so that adjustments made because of possible financial constraints by the Central Working Groups are within the general

acceptance of the State Working Groups and their appreciation of priorities and implementing capacity. This process will be continued at the annual plan discussions for future adjustments in the light of changes in financial resources and demand, and the realities of performance.

2.4.11 The States also need to be closely associated with the formulation of the Central and Centrally-sponsored schemes. Central sector programmes, which are closely tied up with the State sector and Centrally-sponsored schemes, should be finalised through joint working groups of Central and State representatives without making them unwieldy so that the allocations are acceptable and the States are better committed to take complimentary action in relation to these schemes. Also there has to be close integration between the plan and the budget at both the State and Central level through the planning units.

2.4.12 As in plan formulation, Centre has a genuine role in laying down the broad framework of developmental policies and providing guidelines on some of the basic issues connected with the administration of programmes to facilitate timely and uniform action. While the broad norms are laid down by the Centre, the alternative approaches to a problem with their implications should be fully spelt out for the States to take their own decisions adopting the general guidelines to local conditions.

2.4.13 The decision making process should be improved through suitable organisational and other measures. There should be regular evaluations and their results fed into the policy-making process. The feed-back can be facilitated through close contacts between research and development organisations under the control of the Central and the State Governments. Other important measures include the constitution of Agricultural Development Council at the State and Consultative Council at the Central level, activisation of advisory bodies and panels, decentralisation of decision-making and training in agricultural administration and management and economic decision making. The reaction of the States to national policies in other sectors, as they affect State effort towards agricultural production, should also be sought through the forum of the Consultative Council.

Central Aid and Assistance

2.4.14 Central aid and assistance in various forms continue to be the key factor determining the Centre-State relations in agricultural development. Central responsibility in the implementation of Central and Centrally-sponsored schemes in a number of important areas is much greater than before, though this should not mean that the

Centre has taken the responsibility upon itself to implement these programmes. Larger provision in the Central or Centrally sponsored sector is actuated by the need for providing assistance on an earmarked basis for schemes that are basically part of the State sector and the responsibility for implementing them falls upon the administrative and extension agencies under the States or autonomous bodies or agencies in the State sector, through which, in practice these are executed. For a proper correlation between the Central and Centrally sponsored sectors and the State sector, a long-term perspective has to be developed in respect of these schemes and a strategy followed under which they ultimately form part of the State sector. However, the number of such Central and Centrally sponsored schemes should be minimum.

2.4.15 Earmarking of resources for key sectors of development can be secured even while such programmes form part of the State sector. States can issue sanction for these schemes after their details have been worked out in consultation with the Centre. Earmarked Central assistance can be related on the basis of expenditure reported by the States. The system of *ad hoc* Central assistance for emergency production programmes and such other purposes should normally be avoided, as these are associated at the State level with *ad hoc* measures and hastily drawn up schemes. Emergency assistance, where unavoidable, should be accompanied with an assurance of follow-up and complementary measures by the States.

Implementation

2.4.16 Firm understanding and collaboration between the Central and State Governments are essential in the matter of administrative and institutional arrangements for facilitating timely and adequate supplies and services. There should be a definite assurance about the flow of supplies through forward planning. At the Central as well at the State level, there should be a cell in the Inputs Division under the agricultural setup for securing coordination in the organisation of supplies and services.

2.4.17 The scope for Centre-State collaboration in the production and management of critical inputs has expanded. Although there in such collaboration in respect of seeds, absence of suitable organisation at the State level has been an important handicap in the assumption of full responsibilities by the State Governments in the development of the seed industry. Growth of State level corporations, with joint participation of the National Seeds Corporation, the State Department of Agriculture and the agricultural university, is essential to fill this gap.

2.4.18 In the field of related agricultural services like credit, warehousing and storage, Central initiative and Centre-State collaboration are significant. In view of the multiplicity of agencies providing institutional finance, planning and direction regarding organisation and availability of finance should undertaken by the Centre. The role of national *vis a vis* State level institutions should be clearly defined and reviewed continuously to ensure that their basic objectives are not ignored. The model of the National Cooperative Development Corporation (NCDC) can be adopted by other promotional cooperatives at the national level for allowing State participation in their management.

2.4.19 Mutual understanding and adjustment can alone be the basis of a national research system consisting of Central research institutes, research institutes at the State level, agricultural universities and joint ventures between the Centre and the States. The objective should be to utilise the available facilities and expertise for promoting collaboration in research projects and participation in teaching and training programmes.

2.4.20 Centre must be a source of effective guidance in various technical, economic and administrative matters affecting the entire agricultural sector and not only the Central and Centrally sponsored sectors where central participation is more direct. States should be encouraged to utilise the experts under the Central Agricultural Department and the ICAR. The All India Agricultural Service, recommended in Chapter 14, can be the channel for exchange of experience and expertise between the Centre and the States. A close working relationship between the field units under the Central setup and the development and extension organisations at the State level would ensure complementary action in the State sector with regard to the utilisation of facilities created in the Central institutions.

2.4.21 Autonomous organisations provide the appropriate institutional framework for collaborative efforts between the Centre and the States. These bodies can be instrumental in depoliticising decision making and securing a better accord between the Centre and the States. Development corporations at the national level should act as the national grid of development as in the case of river or irrigation grid, milk grid or all India coordinated research projects. There should be a close linkage between the autonomous corporations and agencies and the general development and extension setup in the States to ensure adequate cooperation. In the case of key sectors needing large investments, such as command area development, a Central representative could be associated with the management of the development authority at the State level with the object of evolv-

ing a commonly agreed programme on points of mutual interest for action by the concerned authorities without procedural formalities. Written memorandum of Understanding in suitable cases will remove any uncertainty regarding utilisation of facilities available at the Central and State levels for the programmes covered.

2.4.22 The organisational devices discussed so far may not be applicable to a vast area totally within the States' purview including land management and other legislation, regulatory acts and their administration. In several cases these are found wanting in tackling the basic problems. Lack of uniformity of concepts and procedures, absence of standardisation in legal provisions and machinery for enforcement and other shortcomings can, however, be avoided to a great extent through an agreed legislative framework or national skeletal legislation setting definite norms at the national level in a number of important areas. A comprehensive code or manual dealing with agrarian legislation in the States should be prepared by the Centre which could be adapted by them to suit their local requirements. This would enable better Centre-State and inter-State coordination in enactment as well as enforcement. There should be a well-organised Division in the Central Department of Agriculture and a small Cell in the State Department of Agriculture for making a continuous study of agrarian legislation and preparing a code.

2.4.23 While the Centre should influence through its knowledge and competence and not direct through its controlling powers, the functions of influence and guidance cannot be fulfilled except through deliberately built channels of communication, mutual commitment and cooperative effort. The relationship between the Centre and the States should be periodically reviewed and the organisations and institutions at the two levels and their method of operation adjusted to the new responsibilities thrown up by the development process. The Centre and the States are to be regarded as parts of the same system in which the relationship between the two is guided by the criteria of efficiency and economic necessity and ensured through understanding and adjustment.

5 NUTRITION

Dietary Allowances

2.5.1 The scientific approach to dietary allowances is based on principles of nutrition and the composition of foodstuffs in terms of carbohydrates, fats, proteins, minerals and vitamins. The amounts and proportions of each constituent in diets

vary with age, sex, body weight, occupation and ambient temperature of the subject. The recommended allowances of nutrients, as revised in 1968 by the Indian Council of Medical Research (ICMR) are 2,400 calories and 44 gms of protein.

2.5.2 Dietary habits, evolved through experience, are largely dominated by local availability of foods, which ordinarily, kept the people in normal health. The existing patterns of diets in different parts of the country reveal certain general characteristics of Indian diets, namely, (a) preponderance of cereals, (b) markedly low intakes of protective foods, (c) regional variation in staple foods, such as rice wheat, millets or tubers, (d) consumption of non meat foods due to low income by a large section of the general population. The existing patterns of diets, which are crude averages for different States but indicate, nonetheless, the patterns of consumption of various foods by a large section of the population in the respective States, reveal both qualitative and quantitative deficiencies over space and among groups of population, particularly some special groups like industrial workers and tribals and the vulnerable sections.

2.5.3 National averages of energy and protein consumption in foods are misleading for a populous country like India. Unless data are compiled sectorally according to economic groups, they lose their usefulness for purposes of planning and distribution and nutrition. Because of differences in dietary habits of the people from one State to another, the survey data should preferably be available on a State basis. In view of the divergent weighted values of per capita energy and protein requirements calculated by different expert groups, the ICMR should re-estimate the energy and protein requirement and their distribution according to age, sex, body weight and ambient temperature making usual allowance for the pregnant and lactating mothers and thereby arrive at more reliable per capita values.

2.5.4 Calorie requirement is dependent on age, sex, body weight and ambient temperature. The considerable Statewise variations in both calorie and protein intakes do not indicate energy deficiency or sufficiency of diets as the differences may be consequence of differences in ambient temperatures and body weights. While recommending dietary allowances the various factors determining them should, therefore, be more rationally looked into. A uniform standard of protein and calorie intake should not be enforced. Greater attention should be paid to local foods which are often more beneficial from the point of view of nutrition.

2.5.5 The cost of a nutritionally balanced diet is beyond the buying capacity of a large section of the population, income being the greatest limiting factor. The cost of diet needs to be minimised by

Choosing items from the available food materials including the local ones which provide the recommended amounts of nutrients including the total calorie intake. However, a minimum cost diet may lack palatability and would not be acceptable, even if most economical. With a view to striking a compromise between nutrition, palatability and cost, a series of diets should be prescribed from locally available foods to suit a wide range of pockets. This exercise should be carried out on the basis of a whole region where food availability is of similar pattern. In Appendix 2.1, Statements I to V are presented the monthly requirements for improved diets available at moderate cost, based on rice, wheat and millets as staples. These diets, except for Kerala region, are vegetarian and, therefore, include only milk among foods of animal origin. However, according to availability and buying power of the consumer, egg, meat and fish can be easily incorporated replacing some of those listed.

Effects of Malnutrition and Cost of Malnutrition

2.5.6 The wide prevalence of malnutrition and ill health among large sections of the population, particularly the low income groups is due to the consumption, for long periods, of quantitatively as well as qualitatively deficient diets. The treatment of various types of illnesses and infections among the children, pregnant and nursing women and workers, which arise from prolonged malnutrition, and the liability of rehabilitation of millions cost the nation heavily in addition to the losses sustained from the lowered efficiency in work output. However, the problem of malnutrition cannot be solved unless the devitalising nutrition leakage is checked. The physical well being, environmental sanitation and food processing are to be simultaneously improved so that the consumer is in the right frame of physical and environmental health to derive full benefit from the food materials.

Conserving Quality and Nutrients of Foods

2.5.7 In the context of nutrition management, there is urgent need for the processing of foodgrains and improving storage structure to prevent appreciable loss both in quantity and quality due to microbial and fungal action, rodents and pests. The problem of quality deterioration arising from inadequate drying may be overcome by use of simple mechanical driers. Ratproof godowns are necessary to prevent deterioration due to rodents and insects. Such facilities should, as far as possible, be cheap and developed indigenously. Measures to control storage pests by using chemicals should, however, take precaution against pollution.

2.5.8 Cooking, while making food tasty and easily digestible, and destroying pathogenic bacteria, may also tend to destroy some essential nutrients. But with proper understanding of nutrition one could consciously improve nutritional quality without impairing their gastronomic importance.

Food Production Pattern and Nutrition

2.5.9 From a comparison of the requirements on the basis of improved diets and production of food crops, it is observed that the country has been facing a marginal deficit of cereals and to greater extent of pulses. The deficit is likely to be of wider magnitude in the case of protective foods such as vegetables, milk and other foods of animal origin and also in the case of edible oils and fats. The first priority in production planning should be to meet the quantitative deficit in calorie or energy requirement. Nutrition-oriented programmes of agricultural production as well as of consumption have to be emphasised for the purpose of ensuring adequate amounts and superior quality of cereals, pulses, oilseeds, fruits and vegetables, milk, meat, egg and fish. Cropping programmes enabling diversification wherever possible, and emphasising the high yielding and improved varieties of cereals, pulses and oilseeds, need to be encouraged in view of nutritional significance. Nutrition-oriented food production and consumption planning should be initiated at the district level. A diversification of foods is desirable even for the same nutrient for the sake of complementarity, as is especially true in the case of proteins.

2.5.10 The production of edible oils from plant source has great nutritional significance. Vegetable oils, especially safflower and soyabean are generally good sources of polyunsaturated fatty acids (PUFA) which are required for good health. In respect of safflower, which is high in PUFA content but low in yield, the possibility of combining high yield characteristic with that of high PUFA content by means of genetic manipulation may be explored. Edible oilseeds and oilcakes being supplementary sources of oil and protein, their antinutritional and toxic constituents, if any, should be removed before they are used. In the context of widespread protein-calorie malnutrition, promotional measures should be taken to increase internal consumption of oilcakes. Deoiled and processed groundnut, soyabean, sunflower, cotton seed meals and deoiled rice-bran meal may be used in the production of protein-rich blends of foods for the nutritional rehabilitation of children. Also, it would be more appropriate to process oil meals for export rather than export them as cheap raw materials.

2.5.11 There is vast scope for exploring new sources of edible oil. In order to meet the shortage of edible oils, besides stepping up the production of traditional oilseeds, new sources of edible oils should be fully explored. Oil yields from available sources should be extended by solvent extraction by the use of food-grade solvents. Some of the new sources of non-edible oils would prevent diversion of edible oil for soap manufacture and other industrial uses.

2.5.12 The nutritional significance of vegetables and fruits in general and more particularly leafy vegetables has not been fully recognised by consumers. Their current production and consumption should be augmented through research and extension efforts. The prevalence of vitamin A deficiency and anaemia can be considerably reduced if the intake of green vegetables, which is far below the recommended intake in a balanced diet is increased to even 50 per cent of the recommended allowances. Cultivation of less expensive but nutritive fruits such as custard apple, *ber* and *Sapota* should be encouraged. Appropriate incentives and adequate facilities for storage, transport and marketing of vegetables and fruits should go hand in hand with the increase in their production.

2.5.13 Measures to increase the production of foods of animal origin, such as milk, fish, meat and eggs, have to be intensified in a phased manner. There should be adequate infrastructure for cold storage, quick means of transport and marketing facilities for efficient delivery at the consumer level, without which production will have a set back.

New Foods

2.5.14 While food is scarce and in time to come is likely to get scarcer, even in a global sense, attention of nutritionists and agriculturists has been drawn to new and semi-conventional food materials, which can be processed into edible and acceptable forms. Some of these foods depend primarily on solar energy for their production and hence deserve added attention in an energy-hungry world and where solar energy is more readily available as in India.

2.5.15 Unconventional foods such as algae, yeasts, mushrooms, petroproteins and leaf proteins are expensive from the point of view of initial cost and energy inputs. A selective choice can be made of such foods for production which draw most of their energy from the sun, e.g., leaf protein and algae. However, since technical knowhow for commercial production of such foods is available within the country, efforts should be made to explore the scope of utilisation of these sources as animal feeds. Until research provides clearance on

the basis of toxicological evaluation, these sources should not be utilised for human consumption.

Distribution, Hygiene and quality Control of Foods

2.5.16 Food quality, food safety and food sanitation have been the weak areas leading to health hazards and improper utilisation of good foods and nutrients derived from them. The quality control in regard to raw foods looked after by the Food Corporation of India does not adequately cover all items and, wherever covered, is not properly enforced. The defects have to be eliminated, for which stringent measures are called for.

2.5.17 The danger of food contaminants such as in the case of naturally occurring toxins and chemicals such as pesticides and food additives needs to be elaborately studied. Methods of detoxification as in the case of *Lathyrus sativus* and control of fungal contamination by quick drying and better storage should be popularised through education and extension work. The increased use of pesticides in preharvest and postharvest conditions is apt to result in appreciable pesticide residues which are likely to be harmful to consumers. Apart from education the farmers on the safe use of pesticides, there should be a permanent machinery to conduct a continuous surveillance of the effects of pesticide residues in foods.

2.5.18 The use of irradiation as a means of extending storage life and prevention of deterioration and insect infestation should be examined from the point of view of economic feasibility as well as possible harmful effects of irradiation on the consumer and the nutritional quality of foods. For the purpose of eliminating possible harmful effects, wherever necessary, a minimum period of storage after irradiation should be made mandatory before such irradiated foods are distributed to consumers. For both radioactive fallout and possible harmful effects of irradiated foods, appropriate monitoring agencies should be set up.

2.5.19 At present each State has at least one food and public health laboratory to examine foods for detecting adulteration. Some States have set up regional food laboratories. Food adulteration has become a great menace to health and its effects may be aggravating to the undernourished population. The existing loopholes in the Prevention of Food Adulteration Act should be plugged and punishment for food adulteration made severe and deterrent. Facilities for checking adulteration by on-the-spot tests must be provided and consumer awareness should be aroused through education and consumer guidance societies. In view of the great risk to public health, the Centre should take up the responsibility in the sphere of an exhaust-

tive National Food Sanitation and Safety Act to ensure consumer safety in regard to raw foods, processed foods and food preparations served in catering establishments.

2.5.20 Many industries dealing with processed foods have come into being as a result of industrialisation and urbanisation. Depending as they do on surplus agricultural produce spread over wide areas in the rural sector, industries have to think of smaller viable units of processing located in rural and semi-urban areas. Many of the products currently marketed are not covered by the ISI marking. They and the new ones should be brought under the purview of the ISI as quickly as possible.

2.5.21 Fortification of foods with vitamins and minerals against nutritional disorder may be obligatory for a certain section of the population, but rethinking is demanded in view of experiences in other countries, whether fortification is the real answer to nutritional disorders. Nutritional upgrading of food through food fortification must be carefully examined in the context of food habits which make it doubtful if the fortifying chemicals are properly utilised. Fortification of cereals in a big country like India involves enormous cost apart from problems of logistics. Unless backed by proper monitoring and follow up studies fortification of foods would illserve its purpose. Since sophistication in processing enhances expenditure of energy and hence cost, the food industry must establish that the additive is essential for processing and, at permissible levels, ensure safety and improvement in quality.

2.5.22 Public eating places in towns and cities are an outcome of urbanisation and industrialisation. But the hygienic condition and the quality of food served there leave considerable room for improvement. There should be one eating houses sanitation committee attached to the municipality or the corporation, to supervise periodically all public eating places and enforce minimum sanitary conditions. The assistance available with the regional institutes of catering technology and applied nutrition should be taken advantage of by industrial managements in organising model canteens and restaurants in industrial locations for the benefit of their workers.

Nutrition Rehabilitation Programmes

2.5.23 Nutritional rehabilitation programmes launched by Government and private agencies for the vulnerable groups though having a decided virtue have not been able to attack more than a fringe of the vast problem. In the absence of any follow up action, the actual benefit cannot be correctly estimated. In the implementation of nutrition programmes organisational lapses stand out prominently. The

Government should examine their achievements and bottlenecks and lay greater emphasis on cost, efficiency, management, exploitation of locally available foods, motivating greater participation of the people, effective reach out to the beneficiaries and efficient delivery systems. In the light of the experience gained so far the merits and demerits of the 'take home' and 'on the spot feeding' projects require closer scrutiny. There seems to be scope for rethinking whether the nutrition rehabilitation programmes should be based on family as unit rather than the school child as a unit.

2.5.24 The multiplicity of organisations involved in nutritional relief and rehabilitation programmes calls for coordination amongst them. The coordination committees set up at the district levels for the integration of nutrition programmes involving several organisations should be made to function effectively by bringing into its fold other inter related aspects of community development such as environmental sanitation, control of infection, early immunisation, family care, family planning etc. The Integrated Child Development Service Scheme of Ministry of Education and Social Welfare which embodies a package of service in a spirit of cooperation and coordination amongst the various departments merits support.

2.5.25 Supplementary programmes can be made more effective through education and choice of cheap and locally available foods. In this task Govt. departments such as those of health, agriculture, social welfare, rural development and home science faculties of agricultural universities should work together.

Nutrition and Food Science Research

2.5.26 A review of research carried out so far by various organisations in the country on food science and allied disciplines suggests that there is urgent need for creating a national grid for operational research for streamlining and coordinating the results of research with the definite objectives of applying them to solve actual problems in the field. In the light of experience in the field of research and food science and allied disciplines it is possible to pinpoint a number of important areas in which research programmes should be either initiated or intensified on a priority basis.

Nutrition Education and Extension

2.5.27 As the nature of the food consumed varies at different strata of the society with varying purchasing power of the people, nutrition education should be different for different groups of people. There is great need for setting up agency charged with the dissemina-

tion of information and motivation of the consumer to accept, where necessary, new food and acquire new food habits so that there is greater emphasis on balanced diets. To realise fully the impact of nutritional education programme and to have an extensive coverage the existing infrastructure needs to be strengthened. A vast scope exists and sufficient manpower available for the extensive use of mass media. For nutrition education in the rural and urban areas, all such means should be vigorously exploited and the personnel given adequate orientation to enlarge the scope of nutrition education. Nutrition education should be made compulsory in agricultural, animal science and medical faculties right from under graduate level. Since nutrition education is to start from early childhood it should be included in school curriculum and teachers training curriculum. The various associations and societies established to promote scientific research and scientific awareness in the various regions of the country should reach out and do intensive nutrition education in the community and rural and urban areas and thereby fulfil their social obligations in addition to being academic forums.

Nutritional Policy

2.5.28 Food and nutrition go hand in hand for health. This is, therefore, a strong justification for a well thoughtout and comprehensive food and nutrition policy which should pave the way to better health of the people and brighter prosperity of the nation.

2.5.29 On a national level nutrition is linked with the economy of the country. The aim should be to provide proper nutrition to the people and to fight malnutrition and associated maladies.

2.5.30 The nutritional status should be assessed by means of carefully planning surveys. They should elicit information about the nutritional status of the vulnerable groups of population. The major nutritional problems to be identified are : (a) calorie-protein deficiency; (b) vitamin A deficiency; (c) nutritional anaemia; (d) goitre; (e) fluorosis; and (f) pellagra and lathyrism.

2.5.31 Depending on the pattern of food production as determined on the exigencies of the prevailing situation, broad formulations should be made of the best possible balance sheets commensurate with the minimum nutritional and socio-economic status of the population groups.

2.5.32 The diversion of primary foods for conversion into processed and sophisticated foods to meet consumer demands of urban areas should be restricted to surplus foods only so as to prevent artificial scarcity and hardship to low income groups.

2.5.33 Policy relating to food supply should ensure production of

adequate quantities of pulses, oilseeds, leafy vegetables and fruits for proteins, calories, vitamins and minerals. While the supply of staple foods has to be ensured by maintaining a suitable bufferstock, the preservation of quality through processing, storage and public distribution should be obligatory from the point of view of nutrition.

2.5.34 To get the full benefits of nutrition through better supply and demand formulations, it is necessary to prevent nutrition leakages by controlling infection, immunisation and other integrated health care programmes. This indirect aspect of nutrition needs careful consideration and relevant preventive measures have to be carefully formulated.

2.5.35 Several programmes for nutrition intervention may be formulated and implemented but all of them may not be within the financial capacity. However some of the programmes according to urgency and availability of finance should be launched keeping in mind the enormous cost of malnutrition.

(Paragraph 2.5.5)

APPENDIX 2.1

Improved Diet at Moderate Cost
Statement I—Rice-based (Southern)

Item	gm/day	30 days (kg.)	Protein (gm.)	Calories	Cost * (Rs.)
rice	350	10.50	24.5		
wheat	100	3.00	12.0	1,575 ^a	3.09
pulses	50	1.50	10.0	175 ^c	6.02
leafy vegetables	100	3.00	1.0	50	2.25
root vegetables	30	0.90	0.5	30	1.50
other vegetables	30	0.90	0.5	30	1.35
milk	75	2.25	2.5	50	5.09
sugar/jaggery	50	1.50	..	200	3.23
oil	20	0.60	..	180	4.70
fruits	30	0.90	0.5	20	3.00
groundnut	25	0.75	6.2	14.0	3.23
				57.7	2,450
					63.39

* Based on Average Consumer Price,
1973-74, Ministry of Labour.

APPENDIX 2.1 (contd.)

Statement II—Wheat-based (Northern)

Item	gm/day	30 days (kg.)	Protein (gm.)	Calories	Cost* (Rs.)
wheat	350	10.50	42.0		
rice	100	3.00	7.0	1,575	8.55
pulses	50	1.50	10.0	175	6.02
leafy vegetables	100	3.00	1.0	50	2.25
root vegetables	30	0.90	0.5	30	1.50
other vegetables	50	1.50	1.0	50	2.25
milk	100	3.00	3.5	65	6.78
sugar/jaggery	50	1.50	..	200	3.23
oil	20	0.60	..	180	4.70
fruits	30	0.90	0.5	20	3.00
groundnut	25	0.75	6.2	140	3.23
				71.7	2,485
					52.33

* Based on Average Consumer Price, 1973-74,
Ministry of Labour.

APPENDIX 2.1 (Contd.)

Statement III—Millet-based (I)

Item	gm/day	30 days (kg.)	Protein (gm.)	Calories	Cost* Rs.
jowar	300	9.00	30.0	1,575	14.13
rice	150	4.50	11.0		12.83
pulses	50	1.50	10.0	175	6.02
leafy vegetables	100	3.00	1.0	50	2.25
root vegetables	30	0.90	0.5	30	1.50
other vegetables	30	0.90	0.5	30	1.35
milk	60	1.80	2.0	40	4.07
sugar/jaggery	40	1.20	..	160	2.58
oil	20	0.60	..	180	4.70
fruits	30	1.90	0.5	20	3.00
groundnut	25	0.75	6.2	140	3.23
			61.7	2,400	55.66

* Based on Average Consumer Price, 1973-74, Ministry of Labour.

APPENDIX 2.1 (Contd.)
Statement IV—Millet-based (II)

Item	gm/day	30 days (kg.)	Protein (gm.)	Calories	Cost* (Rs.)
rice	250	7.50	17.5	875	21.38
jowar	100	3.00	10.0	350	4.71
ragi	100	3.00	7.0	300	4.41
pulses	50	1.50	10.0	175	6.02
leafy vegetables	100	3.00	1.0	50	2.25
root vegetables	30	0.90	0.5	30	1.50
other vegetables	30	0.90	0.5	30	1.35
milk	60	1.80	2.0	40	4.07
sugar/jaggery	50	1.50	..	200	3.23
oil	20	0.60	..	180	4.70
fruits	30	0.90	0.5	20	3.00
groundnut	25	0.75	6.2	140	3.23
			55.2	2,390	59.85

* Based on Average Consumer Price, 1973-74, Ministry of Labour.

APPENDIX 2·1 (Contd.)

Statement V—Kerala Region

Item	gm/day	30 days (kg.)	protein (gm.)	Calories	Cost* (Rs.)
rice	250	7·50	14·0	875	21·38
wheat	50	1·50	6·0	175	1·55
tapioca	150	4·50	1·0	225	2·97
pulses	50	1·50	10·0	175	6·02
leafy vegetables	100	3·00	1·0	50	2·25
other vegetables	50	1·50	1·0	50	2·25
milk	60	1·80	2·0	40	4·07
sugar/jaggery	50	1·50	..	200	3·23
oil	20	0·60	..	180	4·70
fruits	60	1·80	0·5	50	5·99
coconut & groundnut	50	1·50	12·5	280	3·77
fish	50	1·50	7·5	100	10·52
			55·5	2400	68·70

* Based on Average Consumer Price, 1973-74, Ministry of Labour.

3

DEMAND AND SUPPLY

1 DEMAND PROJECTIONS

3.1.1 For successful economic planning it is necessary to have a clear perspective of the time path of demand for different agricultural commodities, keeping in view the longterm economic and social objectives. Due to a multiplicity of factors involved and assumptions underlying the projection exercise, it is possible that the actual demand might deviate from the projected level even if the projection models are perfect and the coefficients in respect of the economic determinants of demand reasonably good. However, the functional role of the projections may be said to be fulfilled even if the problem areas are identified.

3.1.2 Attempts have been made under the successive five year plans, and also by several other nonofficial organisations, to assess the likely levels of demand for principal agricultural commodities at the end of respective plan periods. Past experience has shown that, for various reasons, there have been wide variations between the estimated and the actual levels of demand, resulting in corresponding changes in the prices. The following table gives a comparative picture of the changes in total consumption of foodgrains, per capita income, relative wholesale prices of foodgrains and population during the triennia 1960-62 and 1970-72 :

TABLE 3·1
Change in Consumption, per Capita Income,
Prices and Population during 1960—1962 and
1970—1972

	Total consumption (million tonnes)	Per capita income (Rs. at 1960-61 prices)	Relative wholesale price index	Population (million)
1	2	3	4	5
average 1962	during 1960 to	74·32	307·7	101·8
				442·36

1	2	3	4	5
average during 1970 to 1972 . . .	93.34	345.9	116.1	550.72
percentage increase . . .	25.60	12.41	14.05	24.50
elasticity of demand . . .	..	(+)0.46	(-)0.34	..
impact on demand (percent) . . .	25.60	(+)5.71	(-)4.78	24.50

It would be obvious from the above table that total consumption should have gone up by 31.6 per cent on account of the effect of increase in income and population. The actual increase was, however, of the order of 25.6 per cent. Considering the rise in prices and the fact that price elasticity is negative, the actual increase in consumption appears to be consistent with the estimated consumption levels.

3.1.3 Demand projections for selected agricultural commodities (viz. rice, wheat, coarse cereals, pulses, cotton, jute, oils, sugar and gur, tea, coffee, milk, meat, eggs, fish, industrial wood and fuelwood) have been made at the all India level at two points of time, viz., 1985 and 2000 AD and for rural and urban sectors separately. There is, however, need for formulating demand projections at the State level, including for those commodities which are important from the point of view of the State's economy, for which it would be necessary to build up valid economic indicators.

Projections of Consumer Demand

3.1.4 In working out the projections of consumer demand, the following methodology has been adopted :

- (i) The projections have been derived at constant prices using alternative functional forms for different commodities.
- (ii) Demand elasticities, separately for rural and urban sectors, have been derived from the data on consumption expenditure in the NSS 25th Round, using alternative functional forms.
- (iii) All India per capita net availability of different commodities in 1971 has been used as base. The urban-rural distribution thereof has been worked out with the help of NSS 25th Round data.
- (iv) In respect of cotton clothing, the annual level of cloth purchased in 1961-62, as given in the NSS Report, has been taken as the base. The projections of demand for cotton clothing have been derived by deducting from the

projected demand for all clothing, the likely levels of production of man-made fibres.

The assumptions made in regard to the growth of the two crucial macroeconomic variables, i.e. population and income (more specifically, the private consumption expenditure) in the projection of demand are set out in the following paragraphs.

3.1.5 Among the alternative population projections, worked out by both official and nonofficial agencies, the estimates contained in the Draft Fifth Five Year Plan represent, at best, the targets to be aimed at, but may be difficult of realisation. The "Medium-2" projections up to 2001 AD (as on March 1) by Raghavachari¹ appear to be more plausible in the context of current efforts being made towards family planning. These projections, adjusted for July 1, have been adopted for the demand projections. In case the family planning efforts meet with a greater degree of success and the population turns out to be lower than the Medium-2 projections, the resulting surpluses in foodgrains and raw materials could well find suitable export avenues. The adjusted population projections are presented in the Table below :

TABLE 3·2
Estimates of Population—Rural and Urban

(millions)

Year	Rural	Urban	Total
1971	440·66	110·04	550·70
1985	552·73	172·18	724·91
2000 AD	662·49	272·86	935·35

3.1.6 For the period 1971-72 to 1985-86, the projections of private consumption expenditure (PCE), given in the Draft Fifth Plan, have been suitably adjusted to 1971-72 prices with a view to making them comparable with the estimated PCE in 1971-72. As regards the projections for 2000 AD, an overall and long term rate of growth of gross domestic product (GDP) at 5 per cent per annum during 1971-72 to 2000-01 AD has been assumed. This would give a growth rate of 2 per cent per annum in per capita PCE. The estimates of demand, based on these assumptions, may be treated as the high estimates. In order to have an idea about the minimum level of demand, it has been assumed that the rate of growth of per capita PCE

1 Raghavachari, S. 1974. Population Projections 1976 to 2001 : Population in India's Development, 1947—2000 : Sponsored by Indian Association for the Study of Population, New Delhi.

would be one per cent per annum, which broadly corresponds to the past trends. Considering the past trends of rural-urban consumption expenditure, as revealed by the NSS data, and the likely intersectoral growth of the economy in the years to come, it has been assumed that the urban-rural ratio of per capita PCE was about 1.5 in 1971-72 and this would increase to 1.65 in 1985-86 and 1.80 in 2000-01 AD. The following table gives the projections of per capita PCE in rural and urban sectors :

TABLE 3.3
Estimates of Per Capita Private (Final)
Consumption Expenditure

(Rs.)

Year	Rural		Urban	
	low	high	low	high
1971-72	543.7	543.7	815.6	815.6
1985-86	595.4	776.1	982.4	1280.5
2000—01 AD	646.9	860.8	1164.4	1549.5

3.1.7 The expected increase in per capita demand has been worked out by superimposing the income effect on the base level consumption separately for rural and urban sectors. The aggregate consumer demand has been obtained by multiplying these estimated levels by respective population projections. Projected levels of aggregate demand are presented in Appendix 3.1. The aggregate consumption demand for foodgrains is estimated to lie between 168 and 182 million tonnes in 2000 AD.

3.1.8 On the basis of the alternative sets of demand projections, the average per capita availability of calories, allowing for table losses of food items at 10 per cent, would range between 1,980 and 2,230 units in 1985 and between 2,070 and 2,340 units in 2000 AD against 1,870 units in 1971. Besides, fruits and vegetables, starchy roots and tubers will further supplement the availability of calories. The per capita availability of proteins would be between 47.6 g and 53.7 g in 1985, and 49.8 g and 56.4 g in 2000 AD against 45.2 g in 1971.

Requirements for Seed, Feed, Industrial Uses and Allowance for Wastage

3.1.9 While human demand constitutes the major proportion of the total demand for agricultural commodities, there is a significant component of nonhuman/industrial demand for some of these com-

modities, like foodgrains, oilseeds and fish. The requirement of seeds for sowing an area of 123 million hectares (Mha) under different foodgrains in 2000 AD is estimated at 4 million tonnes. The demand for feedgrains for different categories of livestock is estimated to lie in the range of 20 to 25 million tonnes. The proportion of wastage may be around 4 per cent of gross production or about 8 to 9 million tonnes in 2000 AD. It may also be necessary to make an allowance of 5 million tonnes of foodgrains for industrial uses by that year. Thus, the total requirements of foodgrains in 2000 AD for seed and livestock feed and allowance for wastage and industrial uses may lie between 37 and 43 million tonnes, comprising about 19 per cent of gross production against 12.5 per cent at present. In 1985 the requirements for these uses are estimated between 22.5 and 24.4 million tonnes.

3.1.10 Apart from direct edible purposes, oils are also used for soap making, paints, toiletries, lubricants etc. The demand for these uses has been projected to increase from 0.73 million tonnes in 1971 to between 1.49 and 1.76 million tonnes in 1985 and between 2.34 and 2.78 million tonnes in 2000 AD. In regard to fish, the demand for production of fish meal and other industrial uses is estimated to go up from 0.15 million tonnes in 1971 to 0.40 million tonnes in 1985 and 1 million tonnes in 2000 AD.

Projections of Domestic Demand for Raw Jute & Forest Raw Materials

3.1.11 The demand for raw jute is mainly for production of jute goods. Assuming that the internal demand for jute goods would grow at the same rate as in the past two decades, the demand for raw jute and mesta would work out to 6.4 million bales in 1985. Alternatively, estimates of demand for raw jute and mesta for production of jute goods for internal consumption have been worked out for 1985 as well as 2000 AD by superimposing the effect of growth of net national product and population on the consumption of jute goods. These estimates are given in Table 3.4.

3.1.12 Industrial wood is required as a raw material for producing pulp and paper, sawn wood, panel products, matchwood and round wood, etc. The projected requirements of industrial wood for different uses, as also the demand for fuelwood, have been discussed in detail in Chapter 9 on Forestry.

Conclusions

3.1.13 The following table gives the aggregate gross demand for

agricultural commodities for 1985 and 2000 AD :

TABLE 3·4
Aggregate Gross Demand for Important
Agricultural Commodities
(million tonnes except otherwise specified)

	1971	1985		2000 AD	
		Low	High	Low	High
foodgrains . . .	107·9	150·3	162·9	205·3	225·1
sugar & gur . . .	11·5	16·9	21·2	24·0	29·9
vegetable oils . . .	3·2	5·3	6·6	8·3	10·2
cotton (million bales) . . .	5·9	8·1	12·9	10·4	17·2
jute & mesta (million bales) . . .	2·4	4·85	5·90	8·59	11·75
milk . . .	21·7	33·4	44·2	49·4	64·4
eggs (million Nos) . . .	6,040	10,217	15,972	17,419	28,513
meat . . .	0·7	1·1	1·4	1·6	2·1
fish . . .	1·8	2·8	3·4	4·6	5·5
tea (million kg.) . . .	213	329	445	504	695
coffee (million kg.) . . .	38	63	92	104	159
tobacco (million kg.) . . .	255	355	430	479	590
industrial wood ['000 m ³ (r)] . . .	16,292*	30,030	35,180	47,180	64,450
fuelwood (million m ³) . . .	150*	202		225	

* Relates to the year 1970

3.1.14 These projections are based on the best judgment on the key factors which have a bearing on them. It is possible that some of the assumptions, underlying these projections, may not turn out to be valid and may, thereby, vitiate the projections. The demand patterns for certain commodities would also be influenced significantly by the development of alternative products. It will, therefore, be necessary to carefully watch these factors and adjust the demand projections suitably.

2. SUPPLY POSSIBILITIES

3.2.1 The magnitude of domestic demand for selected agricultural commodities in a long term perspective has been estimated in the preceding section. Corresponding levels of likely production or supply of agricultural commodities are presented below.

Land Utilisation and Area under Crops

3.2.2 Land utilisation statistics in India are currently available for 306 Mha out of the total geographical area of 328 Mha. It is anticipated that as a result of the various measures for improvement of agricultural statistics recommended in Chapter 14, reporting area will increase to 318 Mha by 1985. With the growth of population, pressure on land will continue to increase, both from agricultural and

other sectors. Even within the agricultural sector, there will be competing claims on land for crop production, animal husbandry and forestry. Whereas the area not available for cultivation will increase due to increase in area under forests or under the impact of demand for urbanisation and industrialisation, other uncultivated area and fallow lands will decline. On the whole, there may be a marginal increase in the net sown area from 140.4 Mha in 1970-71 to 145 Mha in 1985 and 150 Mha in 2000 AD.

3.2.3 The gross cropped area is estimated to increase from 165 Mha in 1970-71 to 181 Mha in 1985 and 200 Mha in 2000 AD, mainly on account of increase in area under multiple cropping. The extent of area likely under individual crops in 2000 AD is given in Chapter 6 on Crop Production. These estimates are postulated on considerations of agroclimatic suitability. The changes in the cropping pattern in the next decade or so would be influenced mainly by economic and institutional factors, rather than by agroclimatic considerations. The estimates of area under principal crops in 1985 and 2000 AD on these considerations are given in Appendix 3.2. It is estimated that the total area under foodgrains in 2000 AD may remain around the base level (13 Mha), which implies that the relative share of these crops in the gross cropped area may decline from 75 per cent to 61.5 per cent. Area under nonfoodgrain crops would on the other hand, go up substantially.

Perspective Production Levels

3.2.4 In assessing the impact of programmes for provision of inputs like irrigation facilities, fertilisers and area development programmes on agricultural production in a long term perspective the method of production potential has been adopted. The impact of improved high yielding varieties of cereals has not been taken into account separately because yardsticks assumed for the identified inputs are on overall basis.

3.2.5 It has been estimated in Chapter 5 on Resource Development that the gross irrigated area in the country would increase from 38.5 Mha in 1970-71 to 84 Mha in 2000 AD accounting for 42 per cent of the gross cropped area against 23 per cent in 1970-71. The gross irrigated area in 1985 is estimated at 61 Mha. Irrigated area under foodgrains is expected to go up from 30.6 Mha in 1970-71 to 45.6 Mha in 1985 and 51.3 Mha in 2000 AD. Expansion of irrigated area under nonfoodgrain crops would be greater, from 7.9 Mha in 1970-71 to 15.4 Mha in 1985 and 32.7 Mha in 2000 AD.

3.2.6 In the long term perspective, a number of policies and measures would be necessary for improving the utilisation of irriga-

tion potential and for increasing the agricultural production in the command areas of irrigation projects. A beginning in this direction has already been made during the Fifth Five Year Plan period. As estimated in Chapter 5, land preparation work is major and medium irrigation projects would be completed over 8 Mha by 1985 and 29 Mha by 2000 AD. The area under foodgrains likely to be benefited by the programme is 7 Mha in 1985 and 22 Mha in 2000 AD.

3.2.7 Considerable research and development efforts are already being made for scientific and technological improvement in crop husbandry in rainfed areas. About 66,000 hectares have been covered under dry land farming programme during the Fourth Plan period. It is expected that on the basis of the experience gained and scientific advances made, it should be possible to cover about 10 Mha and 50 Mha of net sown area in 1985 and 2000 AD respectively. The area under foodgrains likely to be benefited under the programme is estimated as 8 Mha in 1985 and 40 Mha in 2000 AD.

3.2.8 Based on the past trends, the likely consumption of fertilisers in 1985 is estimated at 6 million tonnes. The consumption of fertilisers would, however, have to be increased to a level of 7 million tonnes in 1985 in order to meet the low estimates of demand for foodgrains and to 8.8 million tonnes to meet the high estimates of demand. Creation of conditions for absorption of about 9 million tonnes of fertilisers is imperative to meet the high estimates of demand for foodgrains in 1985. Consumption of fertilisers would have to pushed up further to 14 to 16 million tonnes in 2000 AD.

3.2.9 The following table gives the additional production of foodgrains on the basis of these programmes :

TABLE 3·5
Additional Production of Foodgrains,
1985 and 2000 AD

Programmes	Yardsticks	Additional Production of foodgrains (million tonnes)	
		1985	2000 AD
irrigation	500 kg/ha	7·5	10·4
command area development	300 kg/ha	2·1	6·6
dry land farming	175 kg/ha	1·4	7·0
fertilisers	10 kg/kg**		
	(a) 28·0*		
	(b) 35·0*		102·0
	(c) 49·0*		
total		(a) 39·0*	
		(b) 46·0*	126·0
		(c) 60·0*	

* The different alternatives correspond to consumption levels of 6.0, 7.0 and 8.8 million tonnes, respectively.

** This might improve to 12·5 kg/kg by the turn of the century.

3.2.10 As a result, the annual production of foodgrains under normal weather conditions is likely to go up from 104 million tonnes in the base period (average for 1969-70 to 1971-72) to 143 million tonnes in 1985 if fertiliser consumption reaches 6 million tonnes. The production in 1985 may, however, reach the levels of 150 or 164 million tonnes in case fertiliser consumption is of the order of 7 or 9 million tonnes. Pushing up fertiliser consumption to a level of 9 million tonnes would involve tremendous efforts, by way of extension and appropriate land policy, to ensure the necessary response of the farmers. These efforts will have to be kept up right upto the turn of the century to realise a production level of 230 million tonnes.

3.2.11 It has been estimated in Chapter 6 that the annual production of important tuber crops, viz. potato, sweet potato and tapioca, would increase from an average of 11.6 million tonnes during 1969-72 to 80 million tonnes in 2000 AD. In 1985, their production is estimated at 36.5 million tonnes. Tuber crops are expected to supplement cereal diets to the extent of 6 million tonnes in 1985 and 14 million tonnes in 2000 AD in terms of carbohydrate content.

3.2.12 The potential for increasing the yield levels in 2000 AD has been discussed in the Chapter 6 on crop production, sericulture apiculture on the assumption that the crops would be grown in most appropriate places at most appropriate times and with full backing of production inputs and that they will be sown on land with proper tilth and interculture of soils made possible through use of ideal inputs and tools. Though these levels are feasible on technological considerations, there may be constraints in the availability of inputs and development of infrastructure on the required scale which would result in shortfall in the realisation of these yields, particularly in the case of foodgrains. It might be difficult to restrict the cultivation of foodgrains to the ideally suitable areas on agroclimatic consideration. Considering these factors, the achievable yield levels and production of important crops are given in Appendix 3.2.

3.2.13 If the programmes envisaged for the development of animal husbandry are implemented (Chapter 7), the production of milk is expected to increase from 21.7 million tonnes in 1971 to 44.2 million tonnes in 1985 and 64.4 million tonnes in 2000 AD. The production of eggs is likely to increase to 16,000 million in 1985 and 28,000 million in 2000 AD. The production of meat from sheep, goats, buffalo, cattle, pigs and poultry is likely to increase from 0.69 million tonnes in 1971 to 1.19 million tonnes in 1985 and 2.10 million tonnes in 2000 AD.

3.2.14 The total production of fish, both inland and marine, is estimated to reach 4.28 million tonnes in 1985 and 8 million tonnes

(including mariculture) in 2000 AD against 1.8 million tonnes in 1971. Inland fish catches are expected to increase from 0.70 million tonnes in 1971 to 2.22 million tonnes in 1985 and 4.50 million tonnes in 2000 AD. Marine fish catches are likely to increase from 1.10 million tonnes as to 2.06 million tonnes and 3.50 million tonnes in the respective years.

3.2.15 If the programmes of manmade forests and natural regeneration are taken up on the scale envisaged in Chapter 9, the production of industrial wood will increase from 15.9 million m³ (r)* to 39 million m³(r) in 1985 and 71 million m³(r) 2000 AD.

Supply—Demand Balances

3.2.16 The outlook for some principal crops is expected to be comfortable even by 1985 and surpluses are expected in respect of commodities like sugar, gur, jute, mesta and tobacco. But in the case of vegetable oils supply is not likely to catch up with the expected demand in the coming years.

3.2.17 The following table presents the supply-demand balances envisaged for 2000 AD :

TABLE 3·6
Supply-Demand Balances —2000 AD

Item	Unit	Supply possibilities		Domestic demand	
		high	low	high	low
foodgrains . . .	(million tonnes)	230		225	205
oils . . .	(million tonnes)	9·7		10·2	8·3
sugar & gur . . .	(million tonnes)	41·0	32·5	29·9	24·0
cotton . . .	(million bales of 180 kg. each)	29·3	24·0	17·2	10·4
jute and mesta . .	(million bales of 180 kg each)	16·7		11·8	8·6
tobacco (dry weight)	(thousand tonnes)	692		590	479
milk . . .	(million tonnes)	64·4		64·4	49·4
eggs . . .	(million nos)	27,882		28,513	17,419
meat . . .	(million tonnes)	2·10		2·11	1·57
fish . . .	(million tonnes)	8·0		5·5	4·6
industrial wood . .	(million m ³ r)	71		64	47

* m³ (r)=Cubic metre round wood.

3.2.18 The realisation of expected supplies would, however, depend upon the extent to which it is possible to provide inputs and mount the extension and infrastructural support for their utilisation. Unless input targets, as envisaged, are properly planned in advance and commensurate efforts made for their utilisation, the food problem may persist. If the high estimates of foodgrains are realised, small surpluses of foodgrains might emerge from 1985 onwards. The surpluses of sugar and gur, jute and mesta as also raw cotton are expected to increase considerably by 2000 AD. The overall supply position of oils, on the other hand, would continue to be somewhat difficult even beyond 1985. To meet the continuing shortages of oils, it would be necessary to make every effort to increase utilisation of tallow and other animal fats, step up research and development efforts to improve the yield of oilseeds and divert some areas under other crops, like sugarcane and cotton to oilseed crops.

3.2.19 In regard to livestock products, the situation of self-sufficiency achieved in 1985 would continue and it might be possible to have marginal exportable surpluses by the turn of the century. Further, the country is expected to be faced with significant surpluses of fish, enhancing the possibilities of their export. In case of industrial wood also the supply-demand situation, is expected to be favourable.

3 EXPORT POSSIBILITIES AND IMPORT SUBSTITUTION

3.3.1 Agricultural commodities and agrobased products constitute an important component of country's export. In 1973-74 these items accounted for 73 per cent of total exports. Agricultural exports will continue to play a pivotal role in the export trade of India till the manufactures and semimanufactures are able to establish export markets. The extent to which agricultural exports are able to fulfil this role will be influenced by the levels of production and domestic consumption of individual items. Vigorous and sustained effort in the agricultural sector is, therefore, crucial for the realisation of targets of growth of exports.

Trends of Exports

3.3.2 After virtual stagnation during the decade 1951-60, agricultural exports from India went up from Rs. 601 crores during 1962-63 to Rs. 965 crores during 1969-70. There has been a further escalation of exports thereafter, largely due to inflation in the world economy and exports of foodgrains to Bangladesh in 1972-73.

India's total agricultural exports amounted to Rs. 1,842 crores in 1973-74 of which agricultural commodities accounted for Rs. 963 crores and agrobased products for Rs. 879 crores. The major agricultural commodities exported from India are tea, oilcakes, cashew-nuts, fish and fish preparations, unmanufactured tobacco, crude vegetable materials, spices, coffee, sugar, raw cotton, vegetable oils and fats, etc. The important agrobased products exported from the country are : jute manufactures, cotton yarn and textiles, leather and leather manufactures, clothing, etc. A characteristic feature of India's agricultural exports is their concentration in a few countries i.e. UK, USA, USSR, Japan etc. Some important directional changes that have recently taken place are that the UK which used to be India's foremost market, has now been relegated to a lower position and the share of USA, USSR and East European countries in exports from India has gone up.

Export Planning

3.3.3 Export planning in India was initiated during the Third Five Year Plan period. The Export Policy Resolution, adopted by the Government of India in 1970, emphasised the need for identification of items with greater export potential and undertaking of special measures and programmes for their development and improvement in order to achieve a 7 per cent rate of growth of exports during Fourth Plan period. Exports have been projected to grow at the rate of 7.6 per cent during the Fifth and Sixth Plan periods and 7 per cent, thereafter. Export potential of important agricultural commodities up to 1985-86 has been assessed by the Planning Commission. The Indian Institute of Foreign Trade has also formulated export projections up to 1978-79. The studies indicate that except in case of a few commodities like fish and fish preparations, export possibilities are better than those visualised by the Planning Commission. There is need for a more detailed assessment of long term export possibilities of important agricultural items in terms of possible destinations.

Export Potential and Possibilities

3.3.4 For the purpose of assessment of export potential and possibilities, agricultural items could broadly be divided into five categories;

- (i) traditional items of exports with declining trends,
- (ii) items with growth potential,
- (iii) commodities with little pull of domestic market,

- (iv) commodities which need further processing before exports, and
- (v) commodities on which research is still necessary before their production could be developed for exports.

3.3.5 Competition from synthetics has retarded the demand for jute goods in some of the important world markets, viz. UK, USA and in a number of East European countries. Yet developments like increased demand for new packaging uses, new consumer uses, etc. hold out a hope for increasing exports from India. Price competitiveness with synthetics will, however, continue to be a crucial factor in furthering export of this item. There should, therefore, be a continuing review of competitive situation of jute goods vis-a-vis synthetic substitutes in consumer markets. Measures are also necessary for achieving a breakthrough in the productivity of raw jute and improving its marketing. Research on developing new uses of jute also needs to be intensified.

3.3.6 India currently exports raw wool and a variety of woollen goods. Exports of fine raw wool should be progressively restricted and those of manufactured woollen goods encouraged instead. Programmes for developing production of fine quality fleeces should be given a high priority to enable the country to enter international markets in woollen garments and carpets.

3.3.7 Competition from other producing countries has badly hit India's exports of lemongrass oil. In view of the growing competition as well as the production of synthetic citral in USA, efforts should be made to maintain the exports of lemongrass oil at levels prevailing in the early sixties. The volume of exports of other essential oils should be increased so that the country could have a share in the rising world demand for essential oils.

3.3.8 In the case of lac, competition from Thailand has led to a distinct fall in the quantity of exports over the past few years. Efforts should be made to develop a consortium approach towards exports of lac. Lac growers should be organised into cooperative societies and should be ensured of reasonable prices as an incentive for increasing production. The capacity of lac bleaching industry should be developed keeping in view the world demand for bleached lac. Further, in view of the existence of multiplicity of agencies concerned with different aspects of lac development a suitable agency should be set up to coordinate their activities.

3.3.9 India's share in the world exports of fresh fruits and vegetables is negligible. With the opening of the Suez Canal, the possibility of exporting bananas to USSR and East European countries and dehydrated potato, onion and seed potato to European countries needs

to be examined. It is necessary to organise the production of vegetables for export purposes in compact areas on scientific lines under the aegis of a public sector or cooperative agency and develop adequate export marketing infrastructure.

3.3.10 Research on conditioning of cashewnuts, heat control, oil bath machinery, etc. should be intensified with a view to reducing the high cost of production of cashewnut shell liquid (CNSL). Efforts should also be made to tap the nontraditional markets which prefer resins rather than raw CNSL.

3.3.11 India's exports of cotton textiles and yarn have witnessed an impressive growth over the past few years. There is a good potential for increasing the exports of cotton textiles to many countries if India could improve the production base for the manufacture of high density fibres and a wide range of sophisticated fabrics. Besides, selective modernisation of exports sector of the industry is also essential to streamline the production meant for export.

3.3.12 Indian handloom products have established their position in the world markets. In order to cash in on this situation, fifty export oriented pilot production centres should be set up in important handloom centres. Sericulture should be extended to new areas to make the industry self-sustaining. There is need for modernising production techniques and exercising greater quality control in the production of silk fabrics in order to promote their exports.

3.3.13 There are good prospects of expanding tea exports in the long run provided a bold export promotion drive, backed by a high level of production is undertaken. A destinationwise assessment of the export possibilities of tea to traditional buyers and to the new markets should be made. A similar assessment should be made for different types of coffee with particular reference to major importing countries like USA, Germany (FR), France, etc. Special attention should be paid to exports to non-quota countries and Japan, which is importing both raw and soluble coffee in increasing quantities.

3.3.14 There is a need for formulating a long term development plan for pepper concentrating on varieties which are in demand abroad. Programmes for popularising Panniyur I variety should be given a high priority. Work on evolving and testing new high yielding varieties of pepper should be undertaken keeping in view their yield, cost of cultivation and quality acceptability in export markets.

3.3.15 Apart from pepper, cardamom and several other spices like coriander, ginger, etc. have good export potential. In the case of cardamom, the State Trading Corporation (STC) should be entrusted with the task of exploring the possibilities of increasing exports to new markets, particularly USA and USSR as well as

Australia. The main strategy should be of meeting the competition from Guatemala by giving extensive publicity to the special quality of Indian cardamom. Fibreless varieties of ginger have a good demand and such varieties with high yielding capacity should be evolved for ensuring steady exports at competitive prices to recapture India's markets of the West. The reasons for fluctuations in the exports of coriander and turmeric need to be studied in detail. In the long run, the prospects of exports of minor spices would depend upon a package of policies aimed at increasing export surplus, controlling speculative trading, subjecting export consignments to compulsory grading and preshipment inspection under Agmark and improving packaging.

3.3.16 There is considerable scope for expansion of exports of various processed fruit and vegetable products from India. The emphasis should, therefore, be on increasing export availability of various processed fruit products e.g. citrus and mango products, orange segments, preserved and peeled banana fingers, banana powder, garlic powder and dehydrated vegetables etc. Exports of cut flowers and bulbs for development of floriculture in the country also need to be encouraged.

3.3.17 There is scope for diversification, both in the matter of destinations of exports and items entering export trade in the case of marine products. Problems of insufficient catch, inadequate deep sea fishing fleet and lack of processing facilities should be attended to for augmenting exports of sea foods. It is equally important to maintain strict quality standards and provide adequate grading and packing facilities.

3.3.18 Export of sugar from India has widely fluctuated in the last decade depending upon the extent of surplus and the prevailing international price situation. For increasing the exports of sugar, efforts should be made to create additional production capacity, divert a significant proportion of the increased production for export and effect improvements in refining and packing.

3.3.19 There is considerable scope for producing certain types of meat, e.g. beef and buffalo meat, lean meat, mutton products of sheep origin for exports, provided health restrictions of importing countries are satisfied and strict quality control and preshipment inspection are undertaken. Special steps should be taken to improve the meat characteristics of buffaloes and utilise unwanted male buffaloes for the export market. Besides, the export of meat should be canalised through a public sector agency, like the STC, to avoid trading malpractices. Hides and skins, animal casings and bristles are other items of livestock origin with good export potential. The Indian brush industry should be encouraged to utilise bristles of higher lengths and turnout brushes of

the standard and finish required by developed countries. Modernisation and improvement of slaughter houses and facilities for processing hides, skins and animal byproducts will help in stepping up the production of quality hides, skins and other animal byproducts like casings, for exports.

3.3.20 India can successfully meet the demand for leather and leather manufactures in the international markets in view of the low wage rates and abundant raw material supply in the country. Finished leather garments and other manufactures have to be developed as export items and funds should be provided for the development of adequate infrastructure for finished leather and footwear branches of the industry.

3.3.21 The possibilities of export of oilcakes to countries like Belgium, Luxembourg, Canada, etc. should be explored. For increasing the exports of oilcakes from India, the major emphasis has to be given to quality aspects. It is also important that the economics of exporting oilcakes and other animal feeds *vis a vis* importing dairy products is worked out and policy in regard to export of livestock feed adjusted accordingly. Compulsory preshipment inspection may be introduced to ensure that quality specifications as prescribed in the export contracts are rigidly adhered to. There is also need to improve the shipping service for the commodity. The possibility of diversifying destinations of exports should also be explored. The existing small and uneconomic expeller units should be replaced by large sized composite crushing cum solvent extraction units.

3.3.22 Scientific processing of forest produce should be taken up on a more systematic basis to augment exports of items like timber/wood, shellac, gums and resins.

New Uses

3.3.23 An important aspect of export promotion relates to the identification of new commodities which could enter export trade and mounting of adequate research on marketing and product development aspects of these commodities. Some of the commodities which merit particular attention are rice, coconut, silk, tinned meat, sophisticated dairy products and minor oilcakes.

3.3.24 Concerted measures are needed to develop new uses of agricultural raw materials of required quality at competitive prices for export purposes. Some areas which should receive special attention are : (a) preparation of instant tea in ready-to-drink form; (b) processing of spices and spice products of export quality; (c) distillation of cardamom oil to the specifications of the foreign markets, (d) pre-

paration of ginger oil and oleoresin from ginger, ginger pickle and sugar preserves, etc.; (e) developing new uses of CNSL; (f) exploring possibilities of producing cattle feed, rum and gin from molasses, (g) developing non-traditional use of press mud and commercial exploitation of pulp obtained as a byproduct from sugarcane/sugar beet industry; (h) developing fruit and vegetable processing industry supported by adequate cold storage facilities; (i) identifying new uses of coir; and (j) making better utilisation of byproducts of rice and wheat straws, bagasse, rice husk, items of legumes, pulses and other vegetation. The High Powered Committee on Processed Agricultural and Food Products in the Ministry of Agriculture and Irrigation should undertake a detailed study of the economic aspects, particularly on costs and returns of alternative uses of byproducts, which would help in the development of export oriented byproducts.

Export Strategy

3.3.25 There are good prospects of stepping up the exports of traditional items and entering new lines of agricultural exports. In this effort, India is likely to be benefited by certain international factors, like reopening of the Suez Canal and better trade relations with the Gulf countries and the Organisation of Petroleum Exporting Countries (OPEC). The expansion of the country's trade in agricultural commodities and processed products would also depend upon the extent of international action in the field of agricultural adjustments, intended to help in the long-term development of agricultural exports from developing countries.

3.3.26 The high living standards in developed countries offer large possibilities for development of export of labour intensive items. Greater attention should be given to identification of new products in which there is long term export potential in these countries. It is also important to explore the possibilities of increasing trade with developing countries. The integrated approach, as adopted by the Economic and Social Commission for Asia and the Pacific (ESCAP) to the problems facing intra-regional trade in rice, would be helpful for promoting similar trade among developing countries in other commodities. Formation of commodity communities or producers' associations should be encouraged to deal with problems facing different commodities.

3.3.27 Export promotion efforts should encompass measures for (a) pinpointing areas of various agricultural commodities in raw, semifinished or finished form, the production of which can be developed indigenously; (b) producing these items at competitive prices; and (c) developing the infrastructure for processing agricultural com-

modities into exportable form and moving them to the ports of exit. Funds should be earmarked for investment on integrated projects for production, processing and exports of suitably identified varieties of agricultural products which are in demand in the foreign countries. Export targets should be laid down not only in overall terms but also according to important destinations.

3.3.28 Productivity increase through greater research and development efforts is essential for generating export surplus in the case of items like cashew kernels, oilseeds, raw cotton, raw jute, spices, tobacco and sugarcane. Towards this end, integrated programmes for development of export oriented agricultural commodities might be jointly organised by the Central and State Governments. The strategy should also provide for producing superior varieties of foodgrains for export purposes and instead, importing cheaper varieties for domestic consumption. Other aspects which need special emphasis relate to measures for ensuring price competitiveness and quality of processed or semiprocessed items. India's exports have in the past been inhibited by high prices. Measures should be taken to correct the disequilibrium between the export prices of Indian goods and those of competing countries in respect of major agricultural commodities, which are inhibiting the expansion of the export capacity.

3.3.29 Restraints on domestic consumption may sometimes have to be resorted to for promotion of exports of certain commodities. The types of controls to be exercised on the internal market in each such case would need specific examination. A suitable link between production, export and domestic consumption of such commodities has to be established in the long run.

3.3.30 The establishment of an organisation, on the lines of the International Cargo Handling Corporation in USA, might help in improving the packing and packaging of Indian goods for export. The Indian Institute of Packaging may be entrusted with the task of getting the latest package designs from selected markets regularly, and exhibiting them to the manufacturers and exporters.

3.3.31 Work will have to be initiated on some important aspects of export marketing, such as identification of markets, collection of information, intelligence and statistics on foreign markets, publicity, etc. With improvements in the present reporting system through the trade representatives of India in a limited number of countries. Indian exporters might be better informed of the possibilities of actual sales. The expert services available in the International Trade Centre and ESCAP Trade Promotion Centre could also be availed of.

3.3.32 The Export Promotion Councils can play an important role in export marketing through planning and promoting market surveys

and collection of market intelligence. However, to be effective, these Councils should be given more autonomy and facilities in the matter of undertaking market surveys and research. They should be suitably strengthened and provided with adequate finance for playing their due role in the export effort. An Export Corporation may be set up to handle those export oriented agricultural commodities which are not being handled by any of the Councils. This Corporation should act as the sole import-export agency charged with the responsibility of planning and developing their production, processing and marketing in an integrated manner.

3.3.33 The provision of adequate and timely finance is indispensable for export production and export marketing. Establishment of an Export Import Bank, as a subsidiary of the Reserve Bank to provide medium and long term export credit and to meet the short term credit requirements of exporters may be considered. An element of flexibility in the export financing procedures should be introduced by developing institutions like factor houses in USA.

3.3.34 Adequate and timely availability of shipping facilities at reasonable freight is essential for increasing the exports of agricultural items. The freight structure needs to be rationalised and unilateral changes in rates eliminated through voluntary arrangements under the aegis of an international body like United Nations Conference on Trade and Development (UNCTAD). A cooperative endeavour between trade and shipping interests is necessary for periodically assessing the supply position of reefer space in relation to requirements. The transport arrangements for perishables should be streamlined for realising their export potential. The Indian Airlines should provide package rates on the transport of perishables meant for export.

Imports and Import Substitution

3.3.35 Imports of agricultural items have to be made mainly to meet shortages in domestic production. Foodgrains have been the principal item of imports during recent years. Self-sufficiency in foodgrains and reduction in the order of annual fluctuations in production are, therefore, important for conserving the scarce foreign exchange resources of the country. Imports of other agricultural commodities like raw cotton, rubber, copra are likely to taper off in view of the development programmes in hand. There is need for encouraging cultivation of varieties of cashewnuts, which are being imported, to cater to the export oriented cashew processing industry, since the import availability from other producing countries is likely to go down rapidly in the coming years.

3.3.36 There is substantial increase in the imports of oils and fats of animal origin in the recent past, which indicates the need for a sizable import substitution effort in this regard. The indigenous availability of vegetable oils should be augmented from sources like minor oilseeds, cotton seeds, rice bran etc. Full and rational utilisation of animal fats, which are available in large quantities from fallen and slaughtered animals is also important.

3.3.37 The imports of dairy products would gradually taper off with increasing output of the indigenous dairy industry. However, imports of skimmed milk powder might have to be permitted for some more years to meet the essential shortages in the milk supply schemes or for manufacture for export of high cost milk products. Import quotas in respect of sophisticated dairy equipment, which are not available in the country should be made freely available for meeting the requirements of new dairy plants and for replacement. Import of fertilisers, crude or manufactured, has increased substantially over the last few years. In order to meet this situation the shortfall in indigenous production of fertilisers should be reduced to the minimum. The use of sulphur in the manufacture of phosphatic fertilisers should be avoided as far as possible as sulphur would have to be imported. Geological exploration should be intensified in search of new sources of raw materials for the manufacture of fertilisers.

3.3.38 The annual maintenance imports of leather and tanning industry are estimated at around Rs. 10 crores. These should be treated as essential imports since these are important for the development of this export oriented industry.

3.3.39 Among agrobased products, there is continued dependence on imports of pulp, paper and paper board. These are, however expected to go down in view of the development programmes envisaged in respect of forestry products.

3.3.40 For improving the country's balance of payments situation, all opportunities for import substitution should be availed of by developing the domestic production of relevant items. However, in the drive to avoid imports, care should be taken to provide for the genuine import requirements of export oriented and agrobased industries (e.g. maintenance imports of leather and tanning industry and cashewnuts, as raw material for cashew processing industry). It is necessary to draw up a well thought-out and effective programme of import substitution based on demarcation of areas where : (a) total import substitution is possible immediately; (b) where it could be envisaged within a short period; and (c) where imports must continue in the near future for meeting essential requirements. Import substitution efforts in the first two categories should receive a high priority.

(Paragraph 3-1-7)

Commodity	Func-tion used	Elasticity of Demand	Projections of Consumer Demand						Projections of Demand (million tonnes %)					
			Base-year per capita avail-ability (kg./year)						2000 AD					
			rural	urban	rural	urban	rural	urban	rural	urban	rural	urban	rural	urban
1	2	3	4	5	6	7	8	9	10	11	12	13	14	—
rice	•	LI	0.4133	0.1770	73.17	59.06	45.77	10.83	41.92	10.48	56.45	17.53	51.77	16.99
wheat	•	LI	0.6705	0.3660	34.53	51.16	23.33	10.06	20.23	9.37	29.29	16.60	25.46	15.58
other cereals	•	LI	0.0018 (—)0.4685	51.52	15.40	28.49	2.24	28.48	2.45	34.16	3.37	34.14	3.65	
pulses	•	SL	0.8517	0.6642	18.55	19.53	13.36	4.37	11.05	3.78	17.10	7.60	14.11	6.59
sugar	•	SL	1.6525	1.1118	5.35	15.15	4.70	3.92	3.40	3.15	6.23	7.08	4.56	5.77
gur	•	SL	0.9650	0.2315	15.45	5.73	11.47	1.09	9.29	1.03	14.77	1.80	11.95	1.69
vegetable oil	•	SL	0.8825	0.9753	2.81	5.27	2.04	1.31	1.68	1.07	2.62	2.34	2.15	1.94
vanaspati	•	SL	1.9757	1.4784	0.63	2.82	0.59	0.81	0.41	0.62	0.80	1.50	0.56	1.17
tea	•	DL	1.8000*	1.0600*	0.34	0.57	287	158	210	119	399	306	278	226
coffee	•	DL	1.3900*	1.5900*	0.06	0.11	52	40	36	27	72	87	48	55
tobacco	•	DL	0.7181@	0.7923@	0.51	0.26	367	63	304	51	474	116	386	93

cotton clothing :

millmade	•	DL	1.8591@	1.6424@	11.57	10.15	15.244	4,933	9,314	3,192	22,153	10,691	13,024	6,687
handloom	•	DL	1.5076@	1.5328@	1.77	1.56	1,976	707	1,325	471	2,768	1,500	1,800	968

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Khadi	.	DIL 1.9868@	1.6977@	0.15	0.13	215	66	127	42	317	145	180	89	
milk	.	SL 1.4607	1.3015	38.29	43.95	32.16	12.01	23.97	9.40	42.39	22.01	31.51	17.55	
eggs	.	DL 1.5473@	1.8736@	9.32	17.56	8,932	7040	5931	4286	12567	15946	8082	9337	
meat	.	DL 1.3263@	0.6352@	1.06	2.00	0.94	0.46	0.66	0.39	1.29	0.82	0.88	0.69	
fish	.	DL 0.7994@	0.8012@	2.49	4.68	1.83	1.16	1.48	0.93	2.39	2.14	1.89	1.70	

* On the basis of NSS—10th Round data

@ On the basis of NSS—16th Round data

@@ The per capita availability of cotton clothing is in terms of metres and that of eggs in actual numbers.

% The demand for tea, coffee and tobacco is in terms of million kg, cotton clothing in million metres and eggs in million number.

APPENDIX 3.2

Estimates of Area, Yield and Production of Principal Crops

(Paragraph 3.2.3)

Area : Mha
Yield : kg/ha
Production : million tonnes*

	Average 1969-70 to 1971-72			1985			2000 AD		
	area	yield	prod.	area	yield	prod.	area	yield	prod.
				1	2	3	4	5	6
rice	.	.	.	37.54	1.1	41.9	38.00	1.6	61.0
wheat	.	.	.	18.01	1.3	23.5	20.00	2.1	41.0
coarse grains	.	.	.	45.57	0.6	27.5	45.40	0.9	40.0
total cereals	.	.	.	101.12	0.9	92.9	103.40	1.4	142.0
pulses	.	.	.	22.15	0.5	11.5	23.50	0.9	22.0
foodgrains	.	.	.	123.27	0.8	104.4	126.90	1.3	164.0
oilseeds**	.	.	.	16.34	0.54	8.8	19.50	0.78	15.2
cotton (lint)	.	.	.	7.60	0.12	5.4	9.00	(a) 0.25	12.5
jute	.	.	.	0.78	1.27	5.4	0.90	(b) 0.23	11.5
mesta	.	.	.	0.32	0.66	1.2	0.32	0.75	1.3
sugarcane (gur)	.	.	.	2.59	4.96	12.8	3.50	6.00	21.0
tobacco	.	.	.	0.45	0.83	0.4	0.50	1.10	0.6

* Production of cotton lint, Jute and mesta is in terms of million bales of 180 kg. each.

**The total production of oils from field crops and other sources i.e. exploitation of cotton seed, rice bran, maize, bajra, coconut, oil palm, etc. is estimated at 5.9 million tonnes in 1985 and 9.7 million tonnes in 2000 AD.

4

CLIMATE AND AGRICULTURE

1 CLIMATE AND AGRICULTURE

4.1.1 Successful farming calls for appropriate decisions in relation to weather for choice of crops, sowing, transplanting scheduling of irrigation, fertiliser application, use of pesticides etc. A knowledge of risk due to adverse weather conditions such as drought, floods, hailstorm, frost and environmental conditions conducive to pest and disease incidence is essential. Following the recommendation of the Royal Commission on Agriculture (1928), the India Meteorological Department (IMD) commenced work on agricultural meteorology in 1932 and has been conducting micrometeorological studies in co-operation with agricultural institutes and the State Agriculture Departments. In 1945, a coordinated Crop Weather Scheme was introduced with a view to collecting meteorological and crop data in a farm environment and studying their interrelationship so as to assess the effect of individual climatic elements like temperature and rainfall on crop yield. But the results obtained could not lead to a fuller understanding of the complex biological processes of the plant which are conditioned by a large number of combinations of the environmental factors. A broadening of the scope of investigation is found necessary to encompass wider considerations like energy budget and water balance. Thus, several aspects of crop-weather relationship, including the relative role of weather and technology, need detailed study. A related point is whether Indian climate has trends, periodicity, points of symmetry etc., which could be used for the purpose of prediction. Another point concerns weather in relation to pests and diseases. The major problem of crop-weather relationship, however, persists.

Climate

4.1.2 The climates of India are varied and diverse. Khasi-Jaintia Hills (Meghalaya) in the extreme east is one of the rainiest areas in the world with annual averages of the order of 1,000 cm.—

1,050 cm., while in the extreme west in Rajasthan there are areas receiving less than 10 cm. The contrasts in climate are striking. The major feature of Indian climate is the alternation of the seasons when the winds reverse in direction twice in the year. The seasonal features are :

- (i) In the winter months of December to February, the principal feature of weather is the passage of western disturbances over the northern areas of the country which receive significant precipitation. The extreme southeast peninsula gets significant rainfall during November and December. In the rear of the area affected by western disturbances in the north, strong cold winds blow and temperature falls considerably giving rise occasionally to cold waves.
- (ii) March to May is a period of continuous rise in temperature over most of the areas in the country. This is a period of severe thunderstorm activity all over the country and where moisture is less, as in the north and north-west, duststorms are more frequent. Rainfall is substantial in Assam and neighbouring areas and in Kerala and adjoining Karnataka and Tamil Nadu.
- (iii) June to September is the雨iest period of the year for most of the country. The monsoon is established all over the country by the end of June. The intensity and degree of monsoon rainfall vary from year to year. The monsoon may set in late with large delays in rainfall, have long breaks in July and August or withdraw earlier.
- (iv) October–November is a transition period. Weather is generally fine except in south peninsula which gets significant rainfall in these months.

4.1.3 Almost the entire country east of longitude 79°E and the west coast have normal annual rainfall of 100 cm; in particular Assam and neighbouring areas and most of the west coast get more than 250 cm. Rainfall in the peninsula excluding coastal belts is generally 50 to 75 cm and in north west India it decreases to less than 30 cm. west of Jodhpur. More than 80 per cent of annual rainfall is received during June to September. The primary concern for agriculture, however, is the distribution of rainfall during periods of crop growth.

4.1.4 The rainfall normals, at present in use, are those published by the IMD which are based on available data during 1901 to 1950. These normals, which are more than two decades old, should be

revised and published early. Another point concerns the normals for shorter periods. If these could be reduced to normals for a uniform period, their usefulness in comparison would be more. A review of the method of working out normals for short periods, districts etc., seems necessary. Percentage departures from normal of rainfall for the various meteorological subdivisions should be worked out for all the years from the beginning on a uniform basis and using the latest normals. To give an idea of the occurrence of different intensities of daily rainfall, frequency tables are available for about 300 stations in the different parts of the country. These tables serve the purpose of indicating frequency of heavy rains in different parts of the country and also their approximate contribution to the annual total. In order that such information is of value to agriculture, it is desirable that IMD should publish for all the taluk stations frequency distribution of daily rainfall using a uniform period of 1901 to 1960. Similarly, since weekly rainfall data may be of use for various agricultural purposes, it is desirable that IMD should publish weekly totals of rainfall of all the stations for which data of at least 20 years are available. The IMD prepares every year an annual summary of snowfall information. The information is qualitative in nature except that based on the reports of observatories, and is inadequate from the point of view of further analysis and use. Efforts should be intensified by IMD to organise a good snowfall network to enable a fuller understanding of its role on subsequent weather and its contribution to river flow. A related subject is the study of glaciers. Except for a few isolated expeditions in the Himalayas, work in this field is almost absent. The IMD, the Geological Survey of India and other connected departments should draw up coordinated programmes of glacier studies with a view to understanding their role in Indian weather.

4.1.5 Indian rainfall is highly variable. Great caution is, therefore, necessary in interpreting the behaviour of rainfall in India. Monthly rainfall variability, even in the rainiest months (July–August) and areas, is as high as 40 to 50 per cent. In September, the coefficient of variation (CV) is higher and in October uncertainty becomes nearly complete. If these aspects are not taken note of in crop planning, risk of uncertainty with consequent failures is great. Therefore, when the next set of normals are worked out, CV also should be simultaneously computed, and both published together.

4.1.6 There is considerable diminution of rainfall over large parts of the country when there are breaks in rainfall. It would be useful to note the order of this decrease in rainfall in different parts of the country. Breaks in rainfall, therefore, should be analysed for

taluk areas and published for general use. Alongwith rainfall data information on the distribution of daily maximum and minimum temperatures, in space and time would be useful in planning for different distributions of temperature ranges. Frequencies of daily maximum and minimum temperatures, heat and cold wave spells and duration in hours of temperatures in different ranges should be prepared and published. Similarly, averages of hourly wind data and frequencies of speeds in different intervals and durations should be published for all the stations for which data are available.

4.1.7 Considerable work in the fields of trends and periodicity in rainfall in respect of individual stations has been done in the country. In dealing with larger areas, a common difficulty has been the lack of data computed on a uniform basis *i.e.* using the same set of normals and the same number of stations. A first requirement is, therefore, publication of complete series of data of all stations with records of 70 years or more and preparation of uniform series for the various meteorological subdivisions of the country.

4.1.8 Periodicity in weather has also been examined in a limited way but so far there is no significant support for any definite period. Moreover, the studies so far undertaken have been limited to rainfall mostly and also to the use of statistical techniques. But the problem of climatic change and climatic prediction is much broader and is a global problem too. The subject of global decrease in temperature in recent decades is engaging the attention of distinguished scientists in the world. International symposia have recently been held to review the present position and explore possibilities of climate prediction. Unless there is a better understanding of the physical processes and causes involved in climatic variations, the problem of prediction will continue to be difficult and complex. In the meantime, the subject would have to be attacked by all possible approaches—dynamic, physical and statistical. All these will need considerable time, effort and concentrated attention. In view, therefore, of the importance of climatic prediction to agriculture, the study of climatic change and prediction should be taken up as a project by the Indian Institute of Tropical Meteorology in cooperation with the IMD, Indian Council of Agricultural Research (ICAR) and other interested Ministries/Departments of the Government of India.

Agrometeorology

4.1.9 Quantitative studies or crop-weather relationships have attempted to interpret crop development in terms of weather factors. It is generally estimated that weather as a single factor can be responsible for as much as 50 per cent of variations in yield which

occur from year to year, the remaining 50 per cent being due to other factors like irrigation, manuring and plant protection measures etc. Although it appears so simple to visualise, the real clue to the changes that occur in a plant lies in the biochemical activities, which manifest themselves ultimately in various external features. An ideal study should include the biochemical aspects together with the measurement of external features for a clear answer to the inherent relationship between the plant and weather.

4.1.10 In India, meteorological and crop data have been subjected to various studies under the Crop Weather Scheme. But if the original question is posed even at this stage whether the plant has been utilised successfully as an indicator of its own yield, the answer is not yet definite. The ICAR should, therefore, include in its future programmes of work biochemical studies for a fuller understanding of crop-weather relationship. In representing the results of crop-weather studies in a quantitative manner, it is necessary to have a clear idea of the influence of individual weather elements on plant growth like the effect of sunshine, temperature or humidity etc., besides rainfall or the moisture deficit. In biological experiments glass houses have been utilised in the past for conducting studies under controlled conditions. An improvement over the glass house approach is represented by the phytotrons which are equipped to stimulate weather with regard to a single element or a combination of various elements, and within which plants could be grown in the same manner as in a field. There is an urgent necessity of having such constructions both in the IMD and all the agricultural universities so that a clear idea of crop-weather relationships under controlled conditions could be obtained. It will be only after such a step that it would be desirable to collect and study data on field scale. At the same time, effort should continue to collect data both on crops as well as on meteorology under field conditions on an all India basis as has been done under the Crop Weather Scheme. It is also necessary that every zone representing a particular pattern of rainfall distribution into which the country has been divided should have at least one fully equipped agromet observatory.

4.1.11 Agrometeorological data are at present handicapped in the absence of direct soil moisture measurements on the field. To remove this deficiency, every taluk should have at least one soil moisture measuring station. As a first step, a minimum target of building up a network of at least 3,000 stations, each covering a taluk must be accomplished in the next few decades. The State Agricultural Departments should also arrange for the publication of soil moisture data.

4.1.12 Evapotranspiration, like soil moisture, is a very important factor in crop growth. At present, the data available relate to computed values using theoretical considerations. But how far this would remain tenable under various kinds of growth of plant communities as represented by various plants, orchards and plantation crops as also by various field crops is difficult to guess. Extensive studies of evapotranspiration should be undertaken in different parts of the country under varying conditions of soil moisture in different soils and using as many plant species as possible representing fields, orchards, plantations and various plants. As a first step, fundamental research should be conducted at all the agricultural universities and the central institutes of the ICAR as well as at the Forest Research Institute (FRI), Dehra Dun on this subject. Based on the results of these studies, a suitable network of stations, one at least in each district, for actual observational measurements should be started.

4.1.13 Phenological observations have been continued by the IMD for many years. Such studies could throw light on certain weather phenomena at crucial time, which can give an early idea of the yield which is to be had from a crop or a tree. It is desirable that the network of phenological observatories in the country should be strengthened so that there is at least one station in each taluk. The selection has to be of nature-grown plants as far as possible.

4.1.14 Many of the pests and diseases are weather controlled. But clear examples of the influence of weather on pests and diseases are rare. The IMD, which has been collecting data on the incidence of pests and diseases in a qualitative manner, has drawn up a scheme to intensify studies on diseases and pests of crop plants as related to weather. It is, however, necessary to involve all the agricultural universities and the central institutes of the ICAR in this task. The ICAR should organise a joint meeting of plant pathologists, entomologists and agricultural meteorologists for evolving a unified approach to the study of the problems of pests and diseases. The study should not only include the relationship under field conditions between weather and pests and diseases but also steps for starting a surveillance service based on meteorological factors which should be helpful in forecasting and controlling epidemics.

4.1.15 A knowledge of microclimate of plant communities can also determine the density which is necessary for optimum growth and yield and also to control pests and diseases. The same objective could very well apply to orchards and forests as well. While a good number of agrometeorological observatories in the country have been located on the farms, the observatories in orchards, plantations

and forests are not adequate. This lacuna should be removed as quickly as possible and observatories in adequate numbers set up in orchards, plantations and forests.

4.1.16 A knowledge of forest-climate interaction is essential for understanding and assessing the extent of modifications of climates due to the conversion of tropical and subtropical forest areas into agricultural lands. In arid and semiarid areas particularly, denudation of forests may affect the water balance of the country. Very little work has been done in India on forest-climate interaction. The IMD, in consultation with the FRI, Dehra Dun and the State Forest Departments should draw up a long term research programme in forest meteorology. Similarly, the microclimate over hills varies widely depending on various factors. There is no scientific pattern of crop most suited to different elevations. The sequence of horticulture, plantations as well as arable crops is required to be determined after taking into account the hill meteorology, the knowledge of which is at present meagre in India.

4.1.17 In the context of livestock production and its future plans, the present meteorological set up exclusively for livestock is very inadequate. There is need for all the institutions dealing with animal research and dairy, piggery and poultry organisations to arrange for meteorological observations considered essential for their work. There is also a need for conducting microclimatic studies within paddocks and barns, which will give an idea of the level of animal comfort that is conducive to higher production. The observatories should be set up in the very environmental condition in which the animals are reared and confined. Studies in recent years have shown practical links between current weather and the epidemiology of diseases of farm animals. Research studies should be undertaken with a view to forecasting animal diseases.

Droughts

4.1.18 Departures from normal rainfall occur frequently but when deficiencies are large, widespread and/or prolonged, drought conditions set in. But rainfall, while it may be a major criterion does not give the complete picture and lower rainfall, that would be fatal to crops in one region may be sufficient for growth in another. Besides rainfall, factors like intensity of evaporation, sunshine, soil, stage of crop growth, etc. have also to be taken into account.

4.1.19 The question whether drought could be predicted from rainfall or drought data series over an area from a knowledge of trends, periodicity, etc. is of considerable importance. Rainfall series

of stations in the country generally exhibit variations of a random nature and have shown no significant trend on the whole. Some of the long rainfall series have been tested for periodicity also, but none of significance has been noted. In addition, spectral analysis of palmer Drought Index Series, available for a number of meteorological subdivisions, has shown some relation to quasi-biennial oscillation and in some cases to sun-spot cycles. The amplitude of the cycle is, however, too small to be of significance. The approach of trends, cycles, periodicity etc. is thus, not feasible for forecasting drought. A comprehensive and systematic study of all past droughts by dynamic and synoptic climatological methods should be undertaken for a better understanding and for forecasting droughts. This important projects may be taken up jointly by the IMD and the Indian Institute of Tropical Meteorology in cooperation with the ICAR.

Weather Bulletins for Farmers

4.1.20 For protection against frost, regulation of spraying of pesticides and protective measures against wind or hail damage, the IMD has been operating a regular weather service for farmers. The weather bulletins carrying daily warnings of adverse weather such as cyclonic storms, strong winds, heavy rains, hail, frost, etc., however, give only meteorological information in a general way including weather forecasts but give no indication of the steps the farmers should take in the light of a particular type of forecast valid for the next 24 or 48 hours. Weather bulletins for farmers should include advice on agricultural operations and should be prepared daily after joint discussions between forecasting officer and agricultural officer deputed by the local Agricultural Department to make them purposeful. A common all-India pattern for a daily joint discussion between the plant scientists and the meteorologists should be drawn up on the basis of the experience gained in Karnataka and Tamil Nadu and compulsorily extended to all the States. The IMD should evaluate each year the performance of farmers' weather bulletin service. The ICAR should consider convening such periodical conferences for evaluation of weather services to farmers and for their improvement. While the present arrangements serve the daily needs, each State should prepare a weekly crop weather bulletin containing a description of the week's weather and crops in the State and a forecast of weather a week ahead. The responsibility for the compilation and issue of the weekly bulletins should be that of the Director of the Bureau of Economics and Statistics of the State with the cooperation of the local Meteorologist, the Director of Agriculture of the State

and a representative from the State Agricultural university.

4.1.21 For the guidance of the Meteorologists, who issue the weather forecasts, Statewise crop-weather calendars in respect of each major crop for each climatologically homogeneous zone have been prepared by the Agricultural Meteorology Division of the IMD in consultation with the crop specialists of the States. The calendars depict the normal dates and duration of various phases of the crop and indicate the weather conditions of significance in each phase. In order to enhance their utility, existing crop weather calendars should be brought upto date. Separate calendars should be prepared for early, normal and late sown varieties of different crops in different areas in the country. They should also be prepared for crops like soyabean, cowpea, safflower, sunflower etc.

Extended Range Forecasting

4.1.22 Forecasts of weather for two days with outlook of subsequent two days are at present issued with a reasonable degree of accuracy. For longer periods, say a week, a month and season, the problem continues to be one of great complexity. A few countries issue such forecasts but the general solution has defied attempts so far. The need for such forecasts for agriculture is, however, very pressing. A helpful approach for prediction of rainfall a year ahead or for longer periods could be by detection of trends and/or periodicity in long term records of rainfall. Studies of a number of stations in the country have, with minor exception (Konkan), not revealed any significant trends or periodicity. In view of the large and complex problems involved, research into various aspects of extended range forecasting should be given priority, and work distributed among the IMD, Indian Institute of Tropical Meteorology and other interested institutions. An advisory working group may be set up with the Director General of Observatories as Chairman and membership from IMD, ICAR and State Agricultural Departments to periodically assess and review the speed of implementation of programmes of work.

Crop Weather Relationship

4.1.23 A number of research institutions and organisations are at present engaged in the study of crop-weather relationships. For a better understanding of the crop-weather relationship, however, it is necessary to assess the physiological response of crop to weather. Towards this objective, firstly, intensive measurements of micrometeorological parameters would have to be made for an assessment of water balance and energy budget in crop environment. These experi-

ments, spread over a relatively short period of about five years, have to be replicated in space and time at a number of places close to one another. These measurements have then to be evaluated in laboratory experiments under controlled conditions. Secondly, climatic data collected from mesoscale network have to be applied to solve practical problems of a farm area of several hundred to several thousand hectares. Data thus collected should be used to (a) explain fluctuations in yield, (b) select times of planting and harvest and (c) guide irrigation scheduling and other cultural operations. Thirdly, data collected on macroscale could be used in development of formulae for forecasting crop yields. Crop-weather studies by the IMD should be intensified and forecast formulae developed district-wise taking into account such additional factors as soil moisture, irrigation, consumption of fertilisers and area under high yielding varieties. Further, such relationships would have to be continually revised to suit the changing conditions. Efforts should be made to collect detailed data on acreage, yield, etc. according to (a) varieties, (b) irrigated and unirrigated and (c) various cultural practices like drill sown, transplanted, broadcast, etc. so that it may be possible to arrive at more precise crop weather relationships. Efforts should also be made to attempt forecasts of acreage under crops on the basis of climatological march of weather and other factors like prices of competing crops.

Weather Modification

4.1.24 Even during rainless spells in the monsoons, the atmosphere has as much precipitable water in some places as during active periods, and extensive clouds may pass over a region without precipitation. Cloud seeding is a technique by which clouds could be induced to precipitate on such occasions. Cloud seeding experiments have been carried out in different countries with varying degrees of success. In India, artificial rain making experiments using warm cloud seeding from ground as well as air have been conducted.

4.1.25 Another field of interest in weather modification in India is hail suppression. Extensive damage by hail is caused to horticultural crops like apple orchards and rabi wheat in ripening stage during the winter, pre-monsoon and post-monsoon seasons. The method used for suppressing hails is over-seeding.

4.1.26 While demonstrable evidence is available for increased stimulation of rainfall in the seeded area, the possibility of indiscriminate seeding leading to decreasing rainfall over the target area also exists. The position regarding hail suppression seems much less

convincing. An increase of 10 to 20 per cent in precipitation in situations where rain would have fallen in the natural course is indicated by the ground based seeding experiments in India. Cloud seeding will be of some value in relieving drought and can lead to significant improvement in crop yields, if carried out successfully at critical periods. The technique of dynamic cloud seeding holds promise as a reliable method of producing artificial rain when suitable clouds exist. The World Meteorological Organisation (WMO) had, however, emphasised that weather modification was still largely at the research stage and operations should be undertaken only after a most careful study by experts of the particular situation on the understanding that the desired end results may not always be achieved. Keeping in view the WMO statement, it is essential and urgent to strengthen both the research and operational aspects of the present organisation in IMD and the Indian Institute of Tropical Meteorology to enable them to conduct further trials and experiments in the next 2 to 3 years to arrive at dependable conclusions.

Research, Education and Training and International Cooperation

4.1.27 In addition to those indicated earlier, mention may be made of some more problems involved in research, analysis and investigation in the field of agrometeorology. In recent years, investigations are in progress on mathematical simulation modelling in agrometeorology for the quantitative evaluation of the effects of agrometeorological factors on the condition and productivity of agricultural crops. This is a welcome development. The present state of work in this field needs review for application of such models to Indian data and conditions. The IMD, in consultation with the ICAR should work out joint programme of study using this approach.

4.1.28 Studies of production functions for crop yields with dated inputs of irrigation water have been undertaken by the Planning Unit of the Indian Statistical Institute, New Delhi. For studying economically optimum use of water it is necessary to know the shape of the crop response function to different quantities of water used by the crop throughout its growth cycle. It is desirable that such studies are extended using actual observed evapotranspiration values which are becoming available at some stations and, in their absence, use of recent compared values. Similarly, studies should be undertaken for a proper evaluation of irrigation and yield relationship of crops.

4.1.29 During the past few decades, a considerable volume of agrometeorological data have been collected and some of them published. It is opportune to carefully examine and review the feasibility

of preparation and publication of a detailed and comprehensive Agroclimatological Atlas giving at least essential agroclimatic maps.

4.1.30 Inservice training of staff in practical observational work assumes considerable importance in the light of the Commission's recommendation, made in the Interim Report on the Establishment of Agrometeorological Division in Agricultural Universities, for the opening of a large network of soil moisture, phenological and other types of observational stations as well as a field observatory under every agromet division. The inservice training of staff for manning various types of agromet observatories should be arranged by the State agricultural organisations in consultation and cooperation with the Agrometeorology Division of the IMD.

4.1.31 Rapid developments are taking place in science and technology and international meetings afford valuable opportunities for mutual exchange of views and discussions. In a field so vital as agricultural meteorology, every effort should be made to depute agricultural meteorologists to meetings of the Commission of Agricultural Meteorology of the World Meteorological Organisation.

Organisation of Meteorological Observatories and Raingauges for Agriculture

4.1.32 The IMD has a wide network of synoptic observatories for recording various weather observations. Besides, there are a number of hydrometeorological observatories for collection of basic hydrometeorological data for planning river valley and flood control projects. In addition, there are agrometeorological stations maintained by the State Governments and other State and Central institutions. To meet the increasing demand for weather data for operational purposes, and for research into various aspects of agriculture including animal husbandry, horticulture, forestry, fisheries etc. there is need for a complete and early review of the existing network of observatories by the respective State and Central Departments and organisations concerned. The programmes for future meteorological network for agriculture including animal husbandry, forestry etc., should have unified development under three broad headings, viz., (a) micrometeorological observatories in selected areas for the understanding of the basic physical interaction between the plant and its environment; (b) mesoscale climatic network designed to provide farmers information to improve their agricultural operations and (c) macroscale regional network designed for better weather forecasting capability. The rainfall organisation in the country should be considered along these lines. The observatories to be opened

should be manned by qualified agricultural staff to ensure quality and reliability of the observations.

4.1.33 Rainfall statistics are extremely valuable to agricultural scientists, planners and administrators. The present arrangements for rainfall registration in India introduced by the 1890 Rainfall Resolution of the Government of India are in a bad shape and particularly so, during the past two decades or more. The exposure and maintenance of raingauges are extremely unsatisfactory. Of the existing raingauges hardly two per cent satisfy the standards. Checking of rainfall data for their accuracy is extremely limited. The problems involved in organising the rainfall registration of the country, which already has 8,000 raingauges and which may increase in number rapidly in future, are considerably complex. The proposed scheme of the IMD to provide accurate and up to date rainfall data according to the national standards of instruments and exposure can only meet partially the needs of the situation.

4.1.34 As a basic policy, the agrometeorological observational organisation including raingauges as required by the State Departments of Agriculture should be controlled and maintained by them. They should provide all the funds needed for the purpose. In line with this policy, every State should immediately review its observational requirements and the organisation needed by it for necessary action. As a first step, every block should have at least one raingauge which should be located in the block development office. The States should examine the present locations etc., of raingauges and take action to shift them to block offices in consultation with and cooperation of the Director General of Observatories, who will continue to be the technical adviser on all matters concerning meteorological observations. This is necessary because rainfall record is a compilation of scientific measurements made according to national and international standards and unless taken in the prescribed manner the usefulness of such rainfall data will be considerably vitiated.

4.1.35 The State Departments of Agriculture will have planning units to look after planning, progress and evaluation of agricultural programmes. Each of the units must have a qualified Agricultural Meteorologist who should look after all matters pertaining to meteorology including the rainfall organisation and arrange for the collection, scrutiny, checking, processing and publication of the data and for supply of data to all concerned. At the Centre, these items of work should be handled by the Directorate of Economics and Statistics. As these form the basic data for analysis, they should also be analysed in the prescribed forms in consultation with the IMD. Since the proposals regarding reorganisation of State level

organisation will involve considerably increased work for the IMD, it should be provided with additional staff for the purpose.

2 RAINFALL AND CROPPING PATTERNS

4.2.1 Farming technology has so much advanced that it is possible to increase crop yields even under rainfed conditions, but the choice of crops would have to depend upon the amount and distribution of the prevailing rainfall. Not only in rainfed farming but even under irrigated conditions, one will have to plan for the most economic and efficient use of water to derive maximum possible benefit from rainfall reducing dependence on irrigation so that the advantage of availability of water could be extended to as large an area as possible. This necessitates a close study of the existing cropping patterns *vis-a-vis* rainfall patterns aimed at determining the nature of changes needed in cropping patterns to make the maximum use of rainwater. In the context of increasing production, it is necessary to examine them to find out possible alternative patterns having higher potential. Accordingly, the Commission undertook a comprehensive study of the rainfall and cropping pattern of the country using taluk as the unit of area. The detailed data of rainfall and crops collected would enable the delineation of the country into suitable agroclimatic regions, as crops represent the integrated effect of several natural factors including soils. The extensive crop and related data thus collected and processed during the present study should provide a valuable source of reference, particularly for planning at levels ranging from taluk to all India, besides its utility for the main purpose of arriving at the future cropping patterns.

Methodology

4.2.2 The methodological features of the study of rainfall and cropping patterns include : (a) use of taluk or tehsil as unit of area; (b) introduction of the coded numerical form to express patterns of distribution of rainfall for the whole year, as also of crops and livestock; (c) inclusion of information on orography, temperature, evapotranspiration, rainfall, soils, irrigation, land use, human and livestock populations, power availability for field operations and yield performance of crops, all of which influence in different ways and degrees the cropping patterns of a place; and (d) presentation of coded information on rainfall, crops etc. on maps of scale 1 : 1 million.

4.2.3 In examining rainfall in relation to crop production the monthly rainfall data are considered most convenient since the annual

or seasonal details do not have much significance compared with details for smaller intervals, nor weekly/fortnightly data can be used as dependable indicators of rainfall distribution for a macrostudy covering the whole country. In order to facilitate examination of the distribution of rainfall during periods of crop production, limits of rainfall, which have closer relation to broad requirements of crops, have been drawn up. The time span of most of the crops is usually of the order of 90 days or longer. Keeping this in view, the following limits have been used in the study :

- (i) Rainfall for greater than 30 cm per month (pm) for at least three consecutive months would be suitable for a crop like paddy whose water need is very high;
- (ii) 20–30 cm pm for not less than three consecutive months would be suitable for crops whose water need is high but less than that of paddy, e.g., maize and black gram;
- (iii) 10–20 cm pm for at least three consecutive months is considered suitable for crops requiring much less water, e.g. bajra and small millets;
- (iv) 5–10 cm pm is just sufficient for crops which are low water requiring, e.g. *moth* (*p. aconitifolius* and ephemeral grasses); and
- (v) rainfall less than 5 cm pm is not of much significance for crop production.

4.2.4 For denoting the year's rainfall distribution using monthly totals, a code having letters of the alphabet with numerical subscripts is employed. The letters denote limits of monthly rainfall as indicated above and the subscripts the number of months in which rainfall indicated by the letters is received. The codes are as indicated below :

symbol	monthly cm	rainfall
A	Greater than 30 cm	
B	20-30	
C	10-20	
D	5-10	
E	less than 5	

The terminology followed in describing and discussing distributions of monthly rainfall is as follows :

terminology	description
(i) rainfall pattern	when a season's (four months) or the years (12 months) distribution is referred to according to context.
(ii) type	when rainfall of any of the five intervals A to E is referred to, e.g. A type, B Type etc.
(iii) category	When range between type is referred to, e.g. A1 to B2.

4.2.5 The southwest monsoon months of June to September form the principal rainy season and outside it, there are hardly a few areas and months with rainfall of even 5 to 10 cm pm. In depicting, therefore, the year's distribution, the portion for June to September is central and it is entered in brackets. To the right is the distribution for the post-monsoon months of October to January and to the left that for the premonsoon months February to May. Thus, the year is divided into three periods of four months each. The arrangement of months in each of the four month periods is in the order of decreasing rainfall and not according to the calendar sequence. To facilitate identification of rainfall of the different months, decoded form according to calendar sequence of each of the distributions occurring in the country has been suitably included and this coding sequence would, therefore, not offer any difficulty. An example of a yearly distribution is D1 E3 (A2 B1 C1) C1D2) the interpretation of which is as follows :

- (i) D1E3 represents the period February to May in which one month's rainfall (usually May) belongs to 5–10 cm type and the remainder three months get less than 5 cm pm.
- (ii) A2 B1 C1 represents the period June to September, in which two months (usually July and August) get more than 30 cm pm, one month (September) belongs to 20–30 cm type and the remaining month, i.e. June, has 10–20 cm type.
- (iii) C1 D3 represents the period October to January in which October belongs to 10–20 cm type and the rest to 5–10 cm pm type.

4.2.6 If an identical rainfall distribution is obtained over two or more adjoining taluks, the distribution is designated as a pattern and the area covered by it is distinguished as a zone and indicated suitably by a Roman numerical. Taluk is the unit of area in the present study and analysis but rainfall data available for analysis are for

individual stations only. Although rainfall is a highly variable element, it is seen that differences in monthly, seasonal and annual amounts are small within short distances and the data of the taluk station could be used as representing rainfall of the taluk for all practical purposes.

4.2.7 Rainfall patterns and zones have been identified for the whole country following the methodology explained above. The data for this analysis are in monthly normals or average of over 2,500 raingauges distributed all over the country. A general description of rainfall of each zone is included while discussing the cropping and livestock patterns of the zone. The rainfall patterns and zones of each State are given in the State Reports together with a map showing these on a scale of 1 : 1 million.

4.2.8 The basic data for the study of cropping patterns of the country are areas under different crops in each taluk expressed as respective percentages of the gross cropped area of the taluk. A large number of crops are grown in a taluk but most of them occupy small areas often less than one per cent. In view of this and as the present analysis covers the whole country, the crops considered as constituting a taluk distribution have been restricted to those which individually occupy 10 per cent or more of the gross cropped area of the taluk. In this process a number of crops with small areas which may be locally important may get excluded. A minimum upper limit of the total areas of crops in a distribution or pattern has been fixed at 70 per cent after several trial computations. The maximum number of crops needed to reach the minimum of 70 per cent of the area limit seldom exceeds 4 or 5. Also, it is only rarely that crops with more than 10 per cent are omitted from inclusion in a cropping pattern. Thus, a combination of crops each occupying not less than 10 per cent of the gross cropped area of the taluk and with a total of not less than 70 per cent of the gross cropped area of the taluk are considered as constituting a cropping pattern provided it is the same over two or more adjacent taluks.

4.2.9 To facilitate analysis and have a broad picture of crop distribution of the country, the crops with their areas have been coded in terms of crop symbols with numerical subscripts to denote per cent areas covered. The codes for crops and the percentage area intervals are as follows :

Crop	Code	Crop	Code
rice	Pd	groundnut	Gn
pulses other than pigeonpea and gram	Pu	oilseeds other than groundnut	O

Crop	Code	Crop	Code
potato	P	oats	Oa
wheat	W	cotton	C
maize	M	other fibres	Fo
small millets	Mt	fodder	F
Jowar Kharif	Jk	Fruits	Fr
Jowar rabi	Jr	plantations	L
Jute	Ju	sugarcane	S
bajra	B	vegetables	V
barley	Ba	chillies	Ch
ragi	R	pigeonpea (tur)	T
gram	G	tapioca	Ta
area coverage (per cent of gross cropped area)		Code	
70 or more	1		
50-70	2		
30-50	3		
10-30	4		
less than 10	5		

*overlapping internal points suitably adjusted.

Rainfall Patterns—Zones

4.2.10 The rainfall distributions of individual stations have been analysed in the manner explained above. All taluks with identical distributions have been grouped together and the patterns drawn up for each State separately. The area covered by each pattern is a zone and the zones are numbered in each State according to increasing rainfall intervals. The areas under each of the patterns (zones) for the periods February to May, June to September and October to January have been worked out for each of the States separately and for the country as a whole. The salient features are discussed below :

- (i) February—May : 72 per cent of country's geographical (reporting area) gets rainfall of less than 5 cm pm and 15 per cent area has 5—10 cm mostly during May. The main feature of this period is that about 90 per cent of the geographical area of the country does not have even one month of 10 cm or more of rainfall i.e. C type during February to May. The higher types are confined to Assam, West Bengal, Kerala and, to some extent, to Tamil Nadu, Karnataka, Himachal Pradesh and Jammu & Kashmir.
- (ii) June—September : In June to September the principal rainy season, areas of patterns/types vary widely. A4/A3 types cover a total area of 7 per cent. A2 B2 has the largest area of 12 per cent and A2B1C1 8 per cent. A2

types are the largest with 25 per cent of total geographical area and all A types together cover 11 per cent and all B types together 22 per cent. C is more than B, with a total area of 29 per cent. C4/C3 area is 9 per cent and C2 about 11 per cent. D area is about 7 per cent E is almost negligible with only 0.6 per cent area.

- (iii) October—January : During October to January 45 per cent area is under E type, i.e. no month has even 5 cm of rainfall. Thirty per cent of the area mostly from Assam to Uttar Pradesh and in the Southern States gets 5—10 cm during October. Fifteen per cent is in 10—20 cm pm class and this covers the east coast belt up to Bengal and areas in north eastern States.

4.2.11 The distribution of gross cropped area according to each of the rainfall patterns of the south west monsoon reveals that A4/A3 covers only 5 per cent of the gross cropped area with A2 covering nearly 24 per cent and A1 nearly 9 per cent. B2 types are 13 per cent and B1 9 per cent. C4/C3 is 12 per cent and C2 areas 12 per cent. All these add up to about 84 per cent.

4.2.12 The four monsoon months constitute the dominant rainfall period in the country. During these four months, the patterns in different areas may vary from A to E type. When one considers the rainfall in the preceding four months and also that in the succeeding four months, the patterns are considerably large in number. Accordingly, the total number of rainfall patterns in the country is 174 as indicated below :

Type	No. of patterns
A	73
B	31
C	49
D	15
E	6
	174

4.2.13 The Statewise breakup of number of patterns is indicated in the main Report. Some of the patterns are common to more than one State. Rainfall maps depicting the rainfall patterns in coded form for the entire year have been prepared and the decoded version of the patterns given in separate State tables.

Rainfall Regions

4.2.14 The number of rainfall zones is 174 into which the country is divided may not seem large for a country of India's size but for

convenience in handling and bringing out clearly areas with different number of consecutive months of 10—20 cm pm, 20—30 cm pm and 30 cm pm or more of rainfall, the various zones have been grouped into bigger units and designated as regions by introducing two simple modifications in the rainfall code used for drawing up the rainfall patterns. Accordingly, the country is divided into 62 rainfall regions and numbered 1 to 62. Region 1 covers areas which do not get in any month even 10 cm rainfall. Regions 2—17 include areas with one or more months during June—September of C type rainfall or higher and these are listed in the increasing order of rainfall distribution. Regions 18—22 have rainfall of 10 cm pm or more for one or more months beginning with October. The other regions 23—62 are arranged in increasing order of rainfall. In what follows a regionwise analysis of crop distribution and cropping patterns is presented.

Cropping Patterns

4.2.15 The 62 rainfall regions are arranged in eleven groups (I-XI). The crop distribution in taluks included in each of the regions has been analysed, and the cropping patterns of the various regions drawn up. The cropping patterns in each of the regions is discussed in sequential order of Groups I to XI. For each region, the distribution of rainfall and list of cropping patterns are indicated together with a brief account of the yield levels of the main crops. The analysis concludes with the remarks on suitability of crops grown in the region and includes suggestions for improvement of production as also for growing alternate crops.

Group I : No month with rainfall of 10 cm or more.

4.2.16 Region 1—E4 (E4) E4 : This is the region with the lowest rainfall in the country, or less than 10 cm pm, during the monsoon. The region accounts for 2.7 per cent of the country's gross cropped area spread over five States—Rajasthan, Punjab, Haryana, Himachal Pradesh and Kashmir. There are 15 cropping patterns; the cropping patterns, which include gram, cover the largest area (35 per cent) and the patterns with bajra, wheat and other pulses cover 16 to 18 per cent of the gross cropped area. The cotton pattern occupies 10 per cent of the total area. Rainfall by itself is totally insufficient for growing crops other than millets. Growing of arable crops will therefore, have to be confined to low lying areas with good retentive soils. This can be done only after adopting appropriate soil conservation measures and water harvesting and other suitable agronomic practices. It is advisable to divert the area of arable crops to forage and econo-

mic tree crops or in mixture. More research and extension efforts will have to be put in with this objective in view.

Group II : Rainfall of 10 cm pm or more for one or two months during June to September.

4.2.17 Region 2 : Pattern E4 (C1 E3) E4 : This region includes 85 taluks of Gujarat, Maharashtra, Andhra Pradesh and Karnataka with a cropped area of 5 per cent of the total cropped area of the country. There are 23 cropping patterns; the rabi jowar patterns cover a third of the cropped area. Groundnut and cotton patterns occupy 18 per cent, bajra pattern 15 per cent and kharif jowar pattern 12 per cent. Pulses and minor millet patterns also occur. Reasons for low yields of bajra and rabi jowar in Maharashtra and cotton in Andhra Pradesh and Karnataka should be examined and necessary measures taken urgently to increase the yields of these crops or for substituting them with more suitable crops.

4.2.18 Region 3 : E4 (C2 E2) E4 : This includes 136 taluks in seven States of Himachal Pradesh and Punjab in the north to Andhra Pradesh in the south and accounts for 8.9 per cent of the gross cropped area of the country. The largest area is in Rajasthan. There are 30 cropping patterns but bajra is grown over one half and wheat over 27 per cent of the gross cropped area of the region. Gram occurs in one pattern covering 9 per cent area. Thus, the patterns including these crops cover 85 per cent of the gross cropped area. With only two months of 10—20 cm pm and with high variability of monthly rainfall, the crops that can be grown are mostly millets. Even for millets, the rainfall distribution is not entirely adequate which is perhaps the reason for the areas under jowar being limited. In Rajasthan, cropping patterns mostly include bajra and other pulses. Yields of gram and wheat in Punjab and Haryana and bajra and cotton in Gujarat are higher than the all India yields. Excepting Gujarat the yield levels of crops without irrigation are on the low side, some of them being less than 50 per cent of all India, as in the case of bajra. It is, therefore, very necessary to remedy the situation either by substitution with more suitable crops or by improving the yield levels of the existing crops by adopting better varieties or agronomic practices including water management techniques.

4.2.19 Region 5 : E4 (D1 C1 E2) E4 : The region accounts for 1.9 per cent of all India gross cropped area; 85 per cent of the area lies in Gujarat and the balance 15 per cent in Rajasthan. The region has 15 cropping patterns of which five are of groundnut, four of maize and three of bajra. The groundnut pattern covers 51 per cent and bajra pattern 23 per cent. There is only one cotton pattern covering

14 per cent of the region. Fodder is also a significant crop. Groundnut yields in Gujarat show large variations, the Relative Yield Index (RYI) ranging from 44 per cent in Surendranagar district to 137 per cent in Junagarh. There is scope for improving the yields of maize and bajra in Rajasthan area by adopting better water management and agronomic practices and by substituting groundnut in Surendranagar district of Gujarat with sunflower.

4.2.20 Region 6 : E4 (B2 E2) E4 : This is small region comprising 0.9 per cent of the country's gross cropped area. Seventy per cent of the total area is in Rajasthan and the rest in Gujarat, but for one taluk in Jammu & Kashmir. Maize, bajra, jowar and wheat are the main crops. There are 8 cropping patterns. Patterns with bajra, maize and jowar (k) cover nearly equal areas and total 95 per cent. Rainfall distribution is suitable for crops like jowar, cotton and groundnut, and almost favourable for maize. The rainfall is in excess of what is generally needed for bajra. Though the crops grown are nearly suited to rainfall distribution, yield levels in Rajasthan area are low. These could be improved by adopting better agronomic practices and improved varieties or hybrids.

Group III : Rainfall for three consecutive months from July or four from June with 10 cm pm or more.

4.2.21 The regions in this group (4 and 7 to 17) generally get good rainfall from distribution point of view. It is, however, necessary to adjust the crops to suit the soil and other factors to get maximum yields.

4.2.22 Region 4 : E4 (C4/C3) E4 : This is the biggest rainfall region in the country. The cropped area is 17 per cent of the country's gross cropped area. It has a total of 287 taluks spanning areas in 10 States from Karnataka and Andhra Pradesh in the south to Uttar Pradesh and Himachal Pradesh in the north. The largest number of taluks are in Maharashtra (103) followed by 60 in Andhra Pradesh and 34 in Uttar Pradesh. The cropping patterns identified number 57 and are distributed mainly among millets, paddy and wheat. The region is dominated by millets, cotton, wheat and pulses. Although the crops grown appear to be suitable to the rainfall situation, the yields are low in the case of almost all the crops grown in the portion of the region in Maharashtra, Madhya Pradesh and Rajasthan, which suggests the need for detailed analysis, research as well as development efforts. Similar efforts are needed in the case of gram and other crops which have low yields in Andhra Pradesh and Karnataka.

4.2.23 Region 7 : E4 (B2C1E1) E4 : The region accounts for 8.7 per cent of the country's gross cropped area and covers 171 taluks

in seven States from Madhya Pradesh to Jammu & Kashmir. Uttar Pradesh has 86 taluks and Rajasthan and Madhya Pradesh 37 and 31 respectively. Punjab and Haryana together have 18 taluks. 38 cropping patterns have been identified with wheat, gram and paddy patterns together occupying 80 per cent of the gross cropped area. The other important crops are jowar, bajra and maize. Wheat yields are the highest in Punjab and Haryana where 80 to 85 per cent of the crop is irrigated. Inspite of a fairly good irrigation support the reason as to why wheat yields in Rajasthan and Uttar Pradesh should not be at almost the same level as in Punjab needs to be looked into. Similarly, examination is necessary with regard to maize in Rajasthan and paddy in Uttar Pradesh. The question as to what extent the yields of wheat grown under rainfall conditions could be raised by providing irrigation support requires study if it is not possible to provide irrigation support to wheat and raise its yields under rainfed conditions. It is worth considering as to why this area should not be diverted to safflower or such similar crops. Paddy yields cannot be high without irrigation support and, therefore, it may be advisable to divert paddy area to maize or other suitable crops after providing for proper drainage facilities.

4.2.24 Region 2 : E4 (B2 C2) E4 : The region has 3.3 per cent of total cropped area and includes 55 taluks spread over six States from Bihar to Gujarat, Maharashtra and Andhra Pradesh. Madhya Pradesh has the largest area. The cropping patterns number 23, of which four are with paddy, five with jowar (k) and three each with cotton and wheat. The main crops are paddy, wheat, jowar, cotton and maize. Rainfall distribution is not suitable for growing paddy but yet it has large areas in Bihar and Uttar Pradesh and to some extent, even in Madhya Pradesh. Paddy in Andhra Pradesh is almost entirely irrigated. The paddy yield levels are low except where the crop is irrigated and the same is true of wheat. Growing of paddy and wheat where yields are low without irrigation does not appear to be advisable. Either irrigation facilities should be developed wherever possible or areas should be diverted to other appropriate crops after study.

4.2.25 Region 9 : E4 (B4/B3 E1) E4 : The cropped area is 2.5 per cent of total and includes areas in Bihar, Uttar Pradesh and Andhra Pradesh. Uttar Pradesh covers half of the region. Nine cropping patterns are identified, which are paddy oriented, and these cover 85 per cent of the area. This is another region much better endowed with rainfall both in terms of quantity and its distribution. But the rainfall distribution is insufficient for paddy which dominates the cropping patterns and consequently the yield is low. Except in Andhra Pradesh, the irrigation facilities required are not available in the rest

of the region. Yields of other crops are also low. This needs a careful examination.

4.2.26 Region 10 : E4 (A1 C3) E4 : The entire region is in Gujarat and its cropped area is 0.4 per cent of all India. Six cropping patterns are discernible; two with groundnut, three with cotton and one with jowar. Groundnut (47 per cent) and cotton (48 per cent) patterns cover together 95 per cent area. The major crops are groundnut in Junagarh area and cotton elsewhere. With the rainfall distribution with A type in July, there can be a temptation for paddy cultivation. Even so, crops other than paddy are being cultivated in this region and with good yields. This can, therefore, be cited as a very good example of an area where cropping patterns have stabilised after taking the minimum rainfall into account. In areas with above average rainfall, drainage aspect is fully taken care of. This example of Gujarat is worth emulating by farmers in other regions.

4.2.27 Region 11 : E4 (A1 B1 C1 E1) E4 : The cropped area of the region is 1.4 per cent of the country's gross cropped area. The thirty six taluks of the region belong to five States, of which 14 taluks are from Gujarat and six from Madhya Pradesh. The region has 11 cropping patterns which centre around jowar, wheat, groundnut and paddy. Bajra and maize are the other crops in the cropping structure. In spite of the fact that rainfall is good for majority of crops grown in the region, except paddy, yield levels of many of the crops are low except in Gujarat. Yields of jowar are fairly good but could have been better. Paddy yields cannot be expected to increase unless irrigation is provided. It is, therefore, necessary to go into the crop structure in detail with a view to bringing about improvement in structure and productivity.

4.2.28 Region 12 : E4 (A1 B1 C2) E4 : The region includes 4 per cent of the gross cropped area of the country and extends over six States—Bihar (8 per cent), Uttar Pradesh (9 per cent), Madhya Pradesh (29 per cent), Gujarat (16 per cent), Maharashtra (30 per cent) and Andhra Pradesh (8 per cent). The cropping patterns number 29 which include seven cotton patterns, five paddy patterns and four each of wheat and jowar (k) patterns. Except in Andhra Pradesh paddy is mostly rainfed with low yields. Cotton yields are low in Madhya Pradesh and Andhra Pradesh but in Gujarat, where the crop is rainfed, yields are well above all India level. The rainfall distribution of the region seems more suited to millets, maize and cotton but not for paddy. Paddy growing without facilities for providing supplemental irrigation does not seem to be feasible. Similarly, low yields of crops in some of the States and good yields in others like Gujarat, under similar rainfed conditions are difficult to explain and need looking into. Cultural practices adopted in the States, where yields are good,

should be studied and extended to other areas in that region, in addition to carrying out the needed research.

4.2.29 Region 13 : E4 (A2 C1 E1) E4 : and Region 14 : E4 (A2 C2) E4 : The rainfall distribution is the same in both the regions and both have areas in Madhya Pradesh, Uttar Pradesh and Himachal Pradesh and region 13 covers in addition areas in Jammu & Kashmir, Rajasthan and one taluk in Punjab. The cropped areas in Regions 13 and 14 are 3.5 per cent and 2.4 per cent respectively. Ninety-one per cent of cropped areas of Region 14 is in Madhya Pradesh. There are 12 cropping patterns in Region 13 and 14 patterns in Region 14. Wheat and paddy have the largest areas in both the regions but in Region 13 jowar (k) and gram patterns also cover substantial areas. Yield levels of paddy and wheat, the two major crops of the regions, are on the low side. Rainfall in September is not sufficient to support paddy crop and irrigation facilities are wanting for paddy as also for wheat. The crop distribution needs detailed examination for evolving and adopting appropriate measures.

4.2.30 Region 15 : E4 (A2 B1 C1) E4 : and Region 16 : E4 (A2 B2) E4 : The two regions have the same rainfall distribution and cover adjoining areas to a large extent with cropped areas of 7.6 and 7.2 per cent respectively of total. Region 15 covers seven States with large areas in Madhya Pradesh, Uttar Pradesh and Bihar and Region 16 five States with bulk of the areas in Madhya Pradesh and Bihar and Orissa. There are 25 cropping patterns in Region 15 and 12 in Region 16. Seventy-three per cent of cropped area is covered by nine paddy patterns in Region 15. In Region 16, 97 per cent of the cropped area is under paddy patterns. Paddy is the main crop of these regions but yields are low, the chief reason being insufficiency of rainfall in September. These regions are more suitable for paddy than other crops and hence necessary steps should be taken for providing irrigation facilities. In case this cannot be done, paddy areas may be diverted to other crops.

4.2.31 Region 17 : E4 (A3 B1) E4 : The region includes taluks in Gujarat and Maharashtra. The total cropped area is 0.2 per cent of all India and paddy dominates the cropping pattern. Water resources through rainfall are more than adequate for growing paddy in valleys and hill millets in elevated areas. Paddy yields are fairly good and could be raised further, especially in Bulsar district of Gujarat. There is good scope for increasing the yields of ragi by adopting better varieties and agronomic practices. Being heavy rainfall areas, there is scope for introducing improved varieties of grasses, forage and legumes. Soyabean in rotation with ragi could be tried. Maize could also be tried. The region is good for production forestry and economic tree crops.

Group IV : Rainy season from October for one to three months.

4.2.32 Regions : 18—22 are included in this group and their rainfall patterns are :

- Region 18—E4 (E4) C1 E3
- Region 19—E4 (E4) C2 E2
- Region 20—E4 (E4) B1 C2 E1
- Region 21—E4 (E4) B2 C1 E1
- Region 22—E4 (E4) A1 B2 E1

Region 18 covers portions of southern States, mostly in Tamil Nadu, and a small pocket in Himachal Pradesh. Region 19 is entirely in Tamil Nadu. Regions 20—22 cover areas on the east coast of Tamil Nadu and Andhra Pradesh. Cropping patterns begin with paddy, cotton, jowar or millets. Paddy yields are high in general. Millet yields are very good in Tamil Nadu and moderate in Andhra Pradesh. Pulse yields are low. The reasons for the same are required to be looked into and improvements brought about.

Group V : Rainy season from September for two to four months.

4.2.33 The following four regions have been considered in this group :

- Region 23—E4 (C1 E3) C1 E3
- Region 24—E4 (C1 E3) C2 E2
- Region 25—E4 (C1 E3) B2 E2
- Region 26—E4 (C1 E3) A1 B1 C1 E1

Regions 23 and 24 which cover taluks in Tamil Nadu, Andhra Pradesh and Karnataka are large in area in relation to Regions 25 and 26 which cover small areas in Andhra Pradesh and Tamil Nadu. Paddy predominates in all areas where irrigation is available. In other areas, millets, groundnut, other pulses and cotton are important. Paddy can be grown only with irrigation and this is what is being done. Conditions are nearly favourable for maize in Regions 25 and 26. Introduction of this crop along with soyabean is worth examining. Measures required to be taken to further increase the yield levels of the existing crops also need examination.

Group VI : Rainy season from August for four or five months.

4.2.34 There are three regions in this group with the following rainfall patterns :

- Region 27—E4 (C2 E2) C2 E2
- Region 28—E4 (C2 E2) B1 C2 E1
- Region 29—E4 (C2 E2) A1 B1 C1 E1

Region 27 is the largest with 1.87 per cent of the total cropped areas covering 61 taluks in the three States of Tamil Nadu, Andhra Pradesh and Karnataka. Regions 28 and 29 are in Tamil Nadu. Region 27 has five paddy patterns but ragi and jowar (k) are major crops. Paddy is the main crop in the Regions 28 and 29. Rainfall distribution favours millets, cotton and groundnut. There are possibilities of diverting area under crops like paddy with a view to introducing protein yielding crops and fodder crops which may be examined along with the possibility of increasing yield levels of existing crops.

Group VII : Rainy season for four months from July or five months from June and October 10—20 cm pm.

4.2.35 This is a large group of seven regions, with the following rainfall patterns :

- Region 30—E4 (C4/C3) C1 E3
- Region 31—E4 (E3 C1) C1 E3
- Region 32—E4 (A1 C3) C1 E3
- Region 33—E4 (A1 B1 C2) C1 E3
- Region 34—94 (A2 B1 C1) C1 E3
- Region 35—E4 (A2/B2) C1 E3
- Region 36—E4 (A4/A3) C1 E3

A major feature of the rainfall distribution in the regions of this group is that there are 4 to 5 consecutive months from July or June with more than 10 cm pm. The total cropped area of the region is only 5.5 per cent of all India. Region 30 is the largest with nearly half the area (2.6 per cent) and covers Karnataka, Andhra Pradesh, Maharashtra, Orissa and a small area in Himachal Pradesh. Paddy dominates whether rainfall is sufficient or not. The only good feature is that it is grown mostly under irrigation and yields are high. It may, however, be necessary to consider as to whether available water could be better utilised for raising other crops on larger area with advantage. This suggestion especially applies to Regions 30 and 31, where the rainfall is good for raising crops like jowar, ragi, etc. Maize can be a good crop for these regions and may be tried. Similarly, soyabean and cotton can be good crops in Regions 31 to 36. Plantation crops should also be considered especially in Regions 33 to 36. Since there is rainfall in October in addition to monsoon months, possibilities of raising pulses and fodder crops in paddy fallows with supplemental irrigation is worth considering.

Group VIII : Rainy season from May for five to seven months.

4.2.36 Regions getting fairly heavy rainfall right from May for 5

to 7 months are included in this group. The rainfall patterns are given below :

- Region 37—C1 E3 (A4/A3) E3
- Region 41—C1 E3 (A1 C3) C1 E3
- Region 42—C1 E3 (A1 E2 C1) E1 E3
- Region 44—C1 E3 (A2 B2) C1 E3
- Region 45—C1 E3 (A4/A3) C1 E3
- Region 47—C1 E3 (B1 C3) B2 E2
- Region 48 : C1 E3 (B3 C1) E4
- Region 49 : C1 E3 (A4/A3) B1 C1 E2
- Region 55 : B1 E3 (A3 B1) B1 C1 E2

The regions cover areas in north east and south and account for 5.6 per cent of the total cropped area. The cropping patterns are dominated by paddy, plantations and tapioca in Kerala and Karnataka. In Assam, West Bengal, Bihar and Orissa, paddy and jute predominate with some wheat and other pulses. Rainfall distribution in the north east is not so favourable for paddy. Moisture stress in September and floods affect yields. There is scope for substitution of paddy with maize and similar crops in Regions 41, 44, 47 and 48 if irrigation support could be provided. Soyabean can also be a good crop for these regions.

Group IX : Rainy season six to eight consecutive months from April or March.

4.2.37 There are seven regions in the group with the following rainfall patterns :

- Region 56—B1 C1 E2 (A1 B1 C2) B1 C1 E2
- Region 57—B1 C1 E2 (A2 B1 C1) E4
- Region 58—B1 C1 E2 (A4/A3) A1 B1 B2
- Region 59—B1 C1 E2 (A4/A3) C1 E3
- Region 60—A1 C1 E2 (A4/A3) C1 E3
- Region 61—A1 B1 C1 E1 (A2 B2) C1 E3
- Region 62—A2 C1 E1 (A4) C1 E3

Except in Regions 56 and 57, rainfall is more than sufficient for supporting paddy. The regions cover good portions of Assam and Kerala. The cropped area of the regions is 4.3 per cent of all India. A major difficulty faced in Assam is the large frequency of floods and heavy rains which affect considerably the production levels. Paddy is the major crop of the region except in Regions 56 and 59 where plantations cover large areas. Cropping structure appears to be satisfactory. In Regions 56—57 paddy could be replaced in high areas with maize and soyabean with advantage. Possibilities of tak-

ing short duration pulses, oilseeds, fodder crops and vegetables appear to exist before and after paddy. The high areas, where raising of plantation crops is difficult, could be used for developing grasslands. These regions are good for production forestry and plantation crops. Tendency of opening up slopy lands for arable crops has to be discouraged.

Group X : Two rainy seasons.

4.2.38 This group has two sub-groups—X (a) and X (b). In X (a) the first rainy season is in May with 10—20 cm pm and the second from August, September or October for three months, two months and one month respectively, all of them being in class 10—20 cm pm. Region 38—40 come under this sub-group and the rainfall patterns are as follows :

Region 38—C1 E3 (E4) C1 E3

Region 39—C1 E3 (C1 E3) C1 E3

Region 40—C1 E3 (C2 E2) C1 E3

These cover areas mostly in Tamil Nadu, Karnataka and a small area in Himachal Pradesh. In Region 38 millets and other pulses are grown. Paddy is taken under irrigation in Region 39. In region 40 the crops grown are millets, other pulses, groundnut and paddy. These are scanty rainfall region with long intervening breaks. It is, therefore, necessary to examine possibilities of putting larger areas under grasses and economic tree crops which can stand prolonged drought better than arable crops.

4.2.39 The sub-group X-(b) includes 6 regions. Their rainfall patterns are as follows :

Region 43—C1 E3 (A2 C1 E1) C1 E3

Region 46—C1 E3 (B1 C2 E1) C2 E2

Region 50—C2 E2 (C2 E2) C1 E3

Region 51—C2 E2 (B2 C1 E1) C1 E3

Region 52—C2 E2 (A2 C1 E1) C1 E3

Region 53—C2 E2 (A2 B1 C1) C2 E2

The two rainy seasons are (a) from January for two to three months and (b) from July for two to four months, except in Region 53 where it is for five months from June. The Regions are in Himachal Pradesh and Jammu & Kashmir and the cropped areas are very small constituting 0.23 per cent of all India. The main crops are maize and wheat but barley, paddy and small millets are important in a few taluks. Cropping structure in general appears to be appropriate. With long rainy seasons and with milder temperature, it would be advisable to pay more attention to fruit crops and grassland development in high lying areas.

Group XI : Rainy season from January for four months.

4.2.40 Region : 54 : There is only one region in this group with rainfall pattern C3 E1 (E4) C1 E3. Rainfall is of the order of 10—20 cm pm and the precipitation will naturally be in the form of snow and has no direct significance from crop growing point of view. This region is entirely in Jammu & Kashmir with 11 taluks, cropped area being 0.12 per cent of all India. Paddy and maize are the main crops with significant areas under wheat and barley. Paddy is irrigated and hence has high yields. Barley yield is low. More attention to grasslands and fruit crops may be desirable.

4.2.41 Just as cropping patterns have been drawn up for each State and region, it is both desirable and necessary to have an idea of the cropping patterns on all India basis to bring into focus the major aspects of the crop structure of the country. The cropping patterns in different States have been analysed and a consolidated all India list drawn up. The total number of all India cropping patterns is 177. Cereals contribute 72 per cent of the patterns (128 out of 177). The maximum number 30 is with paddy and jowar crops. Wheat and jowar have 10 and 20 patterns respectively. Cotton is the next largest with 16. Groundnut has 9 patterns but oilseeds other than groundnut only one. Fruits, tobacco, plantations and fodder have 2 each but there is none with sugarcane or tur. Pulses have in all 14 patterns.

4.2.42 In the foregoing analysis of the cropping patterns in the various rainfall regions, only a brief and general reference could be made to yield levels of crops and this mostly concerns the State yields. This, however, is not sufficient and a detailed examination of crop performance is both necessary and important while assessing suitability of different crops in the various parts of the country. A preliminary analysis of district yields has been made. Relative Yield Index (RYI) values have been prepared for the following 13 crops :

rice, maize, jowar (kharif), jowar (rabi), bajra, ragi, small millets, wheat, gram, tur, total pulses, groundnut and cotton.

4.2.43 Crop performance in relation to rainfall distribution and various other aspects has been discussed in the chapter on crop production.

Suggestions for Future Cropping Patterns

4.2.44 Five steps are visualised in the formulation of future cropping patterns. These are :

- (i) delineation of rainfall patterns;
- (ii) identification of the existing cropping patterns;

- (iii) an idea of the area needed for each crop for national self-sufficiency and ideal location for its distribution.
- (iv) juxtaposition of (iii) over (ii) and studying them together with (i) in order to determine possible changes; and
- (v) consideration of related factors like soil, irrigation, pressure of population, needs of livestock, proportion of forest vegetation, cropped area etc., and then arriving at the future cropping patterns on the basis of (iv).

The scope of the study should envisage ultimately the inclusion of all the above five steps. The States and the Union Territories should prepare studies on rainfall and cropping patterns of the respective areas urgently on a priority basis. The future cropping patterns of each State/Union Territory should be fixed at various levels to enable improvements in the cropping patterns for increased production and productivity. After each State has prepared and examined its suggested patterns, this may be tested in the respective areas and demonstrations held to convince the farmers of the advantages of the new suggestions.

4.2.45 A major feature of the country's agriculture is its large dependence on only two good rainy months of July and August during the south west monsoon months of June to September which form the principal rainy season of the country. Rainfall of the same type is required for not less than three consecutive months for growing different types of crop satisfactorily. The areas under the same type of rainfall distribution for at least three months is less than 20 per cent. Thus, over about 80 per cent of the gross cropped area of the country, rainfall distributions only partially satisfy the criterion for growing different crops successfully. Irrigation support is also not adequate, being only 20 to 25 per cent. Under these conditions, it would be necessary to concentrate attention not only on the drought prone areas as usually understood and classified but also on the remainder of the area which is of the order of 50 per cent. Note in this connection should also be taken of the high variability of Indian rainfall even in the rainiest months of July and August. A permanent solution lies only in reorienting farming methods to the realities of the weather situations as prevail in the country. Indian rainfall by itself is not sufficient to sustain and raise crops over vast areas of the country. It is suited most to crops like millets. If rice or other crops have to be grown with high standards of yields, the situation warrants careful examination for adoption of suitable means. Rice crop is prone to suffer in the categories A2 and B2 unless due provision is made in the rainy months to collect and store

water for irrigation in the lean spells or months. For other crops, there is always a danger from water logging and to avoid it suitable agronomic measures should be adopted right from the beginning.

4.2.46 An important way of bringing success to crop cultivation in rainfed farming is through adjusting the time of sowing to such a date of commencement of rainfall which could ensure a reasonable supply of soil moisture to a given crop at least to begin with. To provide a second line of defence, one has also to keep ready a schedule of other crops which could be sown depending upon the early or late occurrence of rainfall so that the chance of complete failure inherent in placing reliance only on one date and one crop get minimised. Studies on optimum dates of sowing should, therefore, be completed for the whole country in close liaison with the scientists of agricultural universities, institutions and departments for adoption of the results after large scale trials in the fields. The prognosis of an all India character has primarily to ensure that the area and yield levels must meet the changing needs of the country. Moreover full justice cannot be done in a broad national prognosis to local, edaphic, ecological, economic and social factors. Therefore, the cropping patterns to succeed must evolve from the lowest level. This is going to be a long drawn process, in which the present efforts represent only a beginning. Even when local experts have developed the patterns, these have to pass the test of time in actual practice and in that course might require modification again and again. Thus, the determination of future cropping patterns is going to be continuous process for some time to come.

4.2.47 Indian rainfall is variable from place to place, month to month and year to year. Ideal conditions for growing crops prevail only in some areas in the country. In about 25 per cent of the area, precarious conditions prevail, rainfall being 10 to 20 cm pm in not more than 2 months in a year and those are not even consecutive months in some areas. The situation in the low rainfall areas is very much more precarious because of higher variability. The position worsens further in the slopy lands and lighter soils. Taking all these factors into consideration, the highest priority should be given to these regions in providing facilities for bringing as much area as possible under irrigation through all means. Adoption of all kinds of water harvesting techniques within each holding as well as outside, on community basis, will also help in stabilising production.

4.2.48 Continuous improvements will have to be brought about in farming systems applicable to various local situations. In spite of all these measures, there will be need for changing the cropping patterns themselves. Because of pressure of population, land has been

opened and used irrationally. Land use planning has to be done and implemented on a scientific basis. In any scheme of land use planning, consideration will have to be given to the existing as well as future needs and the system of farming suitable for the land. At present, there is too much emphasis on arable crops irrespective of the suitability of land or sufficiency of rainfall. It is, therefore, necessary to restrict growing of arable crops in the most favourable areas which have good retentive soils and are situated in valleys so that the rainfall that occurs could be well preserved in soil profiles and it would be possible also to adopt water harvesting techniques. The remaining areas should be put under forage and under economic tree crops either as sole crop or in mixture. It is only by bringing about such changes in cropping pattern that stability can be brought to agricultural production under rainfed conditions in these low rainfall areas. All this is possible only if research efforts are intensified in this direction and suitable recommendations developed as applicable to different regions.

4.2.49 The remaining 75 per cent of the area in the country receives rainfall of 10 to 20 cm pm or more for three months or longer in a year. It should, therefore, be possible in such areas to get at least one good crop in a year. What is needed, therefore, is to decide on crops which fit best in different regions of the country taking into account the soil, rainfall and other factors into consideration. Attempt has, therefore, to be made to introduce such crops and varieties that fit best in the environmental rhythm of a place. No doubt, the existing cropping patterns have been evolved through ages and they represent the local environmental situations and needs. Cropping patterns have to be flexible and should be adjusted to meet the changing needs taking into consideration the advances in technology.

4.2.50 The studies carried out in the Commission with regard to rainfall and cropping patterns alongwith the existing productivity levels have clearly brought out that there is considerable scope for improving cropping structure in different regions. The synchronising of the rainfall rhythm and crop rhythm does not appear to have been taking place in many places. This is illustrated by paddy which is grown under varying conditions with very low and uncertain yields. A changeover from paddy to crops like maize in such areas would mean increased production by as much as 2 to 3 tonnes per hectare. There are a number of such examples in the country. Gujarat is a good example to prove how good yields can be obtained by adjusting crops taking the minimum in the pattern into account but not the maximum. In other words, if rainfall pattern of a region includes A, B and C classes of rainfall amounts in each of the three consecutive months, it is better to go in

for crops that require C or B amounts of rainfall and not A. In such cases, steps should be taken right from the beginning for drainage of excess water.

4.2.51 At present all irrigation sources in Andhra Pradesh, Tamil Nadu and Karnataka are used mainly for growing paddy. It is necessary to examine as to whether water resources could be put to better use from the socioeconomic as well as from human nutrition and other agronomic points of view. In fact, there is a case for restricting paddy to one season only in the southern States when rainfall amounts are in higher ranges in one or two months and utilising irrigation waters for growing other crops.

4.2.52 It is necessary to give a serious trial to these suggestions. To bring about the desirable changes in cropping patterns, it is, however, necessary to convince the farmers of the advantages of change. This implies greater research in the first instance and intensified extension efforts in the later stages. Urgent steps would have to be initiated on priority basis for determining and adopting more suitable cropping patterns than the existing ones. Detailed studies should be taken up on the lines indicated and keeping in view the proposed targets and suggestions made in the crop chapter, formulate research and extension programmes to achieve the main objective of putting every hectare of land to its best use.

RESOURCE DEVELOPMENT

1 IRRIGATION

5.1.1 Rainfall in most parts of the country is confined to the four rainy months of June to September, while crops need moisture throughout the period of growth particularly during crucial stages, which could be arranged only by artificial watering or irrigation. Irrigation had been practised in India for long, and with the growth of population, and consequent need for larger agricultural production, the requirements of irrigation also increased. There had been some expansion in irrigated area, over time. However, unscientific use of irrigation water had been causing certain ill effects, resulting in some lands becoming totally unproductive. But, there is no doubt that in the present context, irrigation has to be expanded to the utmost level to meet the increased requirements of food and raw materials of a larger population. Towards this end, water resources have to be harnessed fully and managed and utilised more efficiently. Financial policies too need to be reoriented to achieve these objectives.

Water and Land Resources for Irrigation

5.1.2 The annual average rainfall received on the total area of 328 Mha in the country is about 120 cm, which yields an annual precipitation of 400 million hectare metre (Mham). According to a comprehensive assessment made by the Commission, the total annual basic water resources of the country are 185 Mham comprising 135 Mham of surface water and 50 Mham of groundwater resources. On full development the total annual basic ground water resources would increase to 85 Mham and the surface water to 185 Mham including 45 Mham regenerated from groundwater. Besides, some credit can be taken for underground fossil water, surface flows from glaciers and permanent snows and expensive desalinated water from the sea.

5.1.3 The utilisable flows aggregate to about 105 Mham—70

Mham from surface sources and 35 Mham groundwater. Not all of this water is available exclusively for irrigation as there are other demands on it like municipal and industrial needs. It is expected that in 2025 AD about 77 Mham of water would be available for irrigation and the rest would go for domestic and industrial uses.

5.1.4 With all the changes envisaged in the pattern of land use, the net sown area is expected to rise from 140 Mha in 1970-71 to 150 Mha in 2000 AD and 155 Mha in 2025 AD. The total cropped area is expected to increase from 165 Mha to 200 Mha and then to 210 Mha over these years, the intensity of cropping for irrigated and unirrigated area together going up from 118 per cent to 136 per cent. Taking relevant factors into consideration, the ultimate irrigation potential is broadly assessed at about 110 Mha. This would be 52 per cent of the sown area of 210 Mha expected in 2025 AD. About 70 Mha will be irrigated from surface sources and 40 Mha from groundwater. The estimate is substantially higher than the estimate of 81 Mha made by the Irrigation Commission (1972). Of the utilisable surface waters, the surplus waters in a river, such as in the Brahmaputra, the Ganga and the west flowing rivers of south of the Tapti, should be utilised, wherever feasible. In other basins where there is paucity of water, all such possibilities should be examined and considered.

Past Development of Irrigation

5.1.5 Works on large scale irrigation projects began in the second quarter of the last century. They were commercial ventures and proved very remunerative. The great famines of the last quarter of that century led to the development of protective irrigation in famine prone areas. Minor Irrigation works like wells, tanks etc. generally belonged to the private sector. The later, however, began receiving attention only from the early forties of this century under the Grow More Food Campaign. On the eve of Independence there were 28.2 Mha receiving irrigation, which constituted 24 per cent of the net cultivated area in undivided India.

5.1.6 Partition resulted in a substantial reduction in the proportion of irrigated area to 20 per cent of the cultivated area. The situation called for tremendous efforts to make up the leeway and meet the requirements of a growing population. The five year plans accorded a high priority to development of irrigation. Greater attention was paid to minor irrigation following the droughts of 1965 and 1966. The gross irrigated area increased from the pre-plan level (1950-51) of 22.6 Mha to 42.3 Mha at the end of the Fourth

Plan (1973-74). Irrigation from surface sources at the two points of time was 16 Mha and 26 Mha respectively.

Groundwater

5.1.7 The extent of groundwater resources varies from State to State. The amount of usable groundwater in the country, on full development of surface water resources and adoption of measures for increased infiltration, may ultimately be of the order of 35 Mham, of which 26 Mham would be available for irrigation.

5.1.8 As groundwater is of local importance, it is necessary to organise areawise assessment so that these resources could be exploited in a planned manner. The expenditure on such surveys and investigations would be nominal compared to the cost of their exploitation and hence should not be neglected. The construction of storage dams affects groundwater table both upstream and downstream. While planning for a storage scheme, a careful study should, therefore, be made to assess its effects on wells downstream. The study should be repeated a few years after the construction to check on the assumptions made earlier.

5.1.9 It is of utmost importance that all relevant information, particularly strata charts and drilling logs prepared at the time of putting down drill holes for investigation, is carefully tabulated and analysed for reference. As these data are generally maintained in respect of State tubewells, the problem is mainly in respect of private tubewells. In the Act that State Governments may enact for the development of the groundwater, there should be a provision that the drilling agency, which drills to depths of more than 30 metres, must furnish a copy of the drilling log to the State Groundwater Board for record and use in sub-surface geological mapping. The State Boards should also make a systematic attempt to secure copies of logs of existing private deep tubewells for the same purpose.

5.1.10 There has been significant increase in the number of wells during the last two decades. Their number rose from 3.64 million to 1956 to 5.11 million in 1966 and further to 6.10 million in 1971. Easy credit from institutional sources, expansion of rural electrification and profitability of farming as a result of the introduction of high yielding varieties, encouragement of multiple cropping and an incentive oriented price policy were the main contributory factors. More than 70 per cent of the open wells in the country in March, 1969 were operated with indigenous lifting devices and less than 30 per cent were fitted with pumps. Side by side with the expansion in well irrigation, a large number of wells are going out

of use. The States, where a substantial number of wells have gone out of use should enquire into the causes, and evolve remedial measures so that investments already made on these wells are not altogether wasted.

5.1.11 In March, 1969, there were 261,000 irrigation tubewells in the country, including 15,000 State tubewells. Most of the tubewells are privately owned. The growth of private tubewells has been significant from the Third Plan onwards. While State tubewells generally tap deep aquifers and give on an average a discharge of about 135,000 litres per hour and irrigate about 80 to 100 hectares of gross area, private tubewells are mostly shallow, having a discharge of about 30,000 litres per hour and irrigate about 4 to 8 hectares. The deep tubewells, because of the high cost involved, are best undertaken by the State; all other groundwater development should appropriately be in the private sector. Farmers should be assisted with credit, technical know-how and equipment to the extent necessary. Joint ownership of tubewells, as it facilitates fuller utilisation of investment, should be encouraged.

5.1.12 Electrical pumps are cheaper both in capital and operating cost. While State tubewells are mostly electrically operated, nearly a third of private tubewells are diesel operated. In view of the economic superiority of electric pumps, the power requirement for irrigation purposes should be met on priority basis and an uninterrupted and unfluctuating supply of it ensured. It is also desirable that programmes of constructing power distribution lines and tubewells and of installation of pumps on open wells should be properly coordinated.

5.1.13 Groundwater development being largely uncontrolled, there has been over pumping in several areas creating serious problems like permanent lowering of groundwater table, as in parts of Tamil Nadu and Gujarat. The State must intervene and rationalise the extraction and distribution of groundwater. Legislation for regulating and controlling its use is urgent, especially in the States where there is over exploitation.

5.1.14 With the rising demand for use of groundwater, the question of legal right to it arises. In any groundwater basin, the available groundwater, after allowing for non-agricultural requirements, should be deemed to pertain to the land and each holding weighted in respect of the quality of the soil should have a legitimate right to a proportionate share of the water. If a farmer constructs a tubewell, which yields more water than the share of his holdings, it should be permissible for farmers having contiguous holdings to avail of their share on payment of share cost.

Development of Water Resources

5.1.15 In view of the complete inadequacy of water resources to meet the agricultural and other requirements, it becomes a matter of great national importance that the available resources are conserved and utilised most judiciously and economically. There has to be proper planning for water use with river basins/sub-basins as natural units of such a plan, to provide a comprehensive outline of development possibilities of land and water resources of basins, establish priorities in respect of water uses for various purposes and indicate *inter se* priorities of projects.

5.1.16 Irrigation policies, in general should envisage :

- (i) maximum production per unit area through multicropping in areas with ample water resources;
- (ii) maximum production per unit of water in regions of medium and low rainfall, in which a large part of the country lies;
- (iii) provision of maximum protection in drought areas;
- (iv) irrigation of maximum area during the rainy season by supplementing rain;
- (v) maximum utilisation of irrigation supplies from storage during the eight months of the year excluding summer months when evaporation losses are highest; and
- (vi) conjunctive use of surface water and groundwater

5.1.17 For supplemental irrigation in canal tracts, groundwater is best exploited by farmers and they should be encouraged to harness it by providing them with credit, technical advice etc. At present, there are some restrictions on exploiting groundwater in canal commands. These should be reviewed with a view to relaxing them to the extent feasible. In areas in the Indo-Gangetic plains and the red soil tracts of the peninsula where water may not be available in the rivers or streams for rabi irrigation, the rainy season flows could be diverted to such streams for kharif irrigation, thereby improving groundwater charge and making water available for rabi irrigation. Schemes for such conjunctive use should be investigated and, wherever found economically sound, taken up for implementation.

5.1.18 In low rainfall areas tree growth generally gets inhibited resulting in shortage of fuelwood, small timber, treefodder etc. Sufficient evidence is available that plantation of trees can be raised economically and profitably with a little irrigation. In formulating new irrigation projects, particularly in low rainfall areas, attempt should be made to create irrigated plantations in compact blocks to

provide small timber, fuelwood and tree fodder in the area.

5.1.19 Hitherto, reports on irrigation projects have been prepared in two parts viz engineering works right from the storage or diversion works to water courses and including drains, and command area development. Keeping in view that the latter includes some one-time items of works, such as land-levelling and shaping, construction of water courses, field channels and drains, and other programmes concerning Departments of Agriculture, Animal Husbandry, etc., an irrigation project report should be formulated in three parts as under :

Part I—all engineering works from source of supply up to outlets and drains;

Part II—all engineering works in the command area comprising land levelling and shaping, construction of water courses, lined or unlined, field channels, field drains and farm roads; and

Part III—all other items pertaining to agriculture, animal husbandry, forestry, fisheries and cooperation.

5.1.20 For Part I of the report, meteorological data are to be compiled and analysed, hydrological observations carried out and analysed, geological and topographical investigations undertaken, preliminary soil surveys done and other explorations and investigations necessary for planning and designing the engineering works made. The scope of Parts II and III is spelt out in the following section on Command Area Development. Investigations of all items for the project report should be taken up simultaneously and the report considered for sanction in its entirety and not in parts. In the past, investigations pertaining to Parts II and III were taken up much later, and in several cases after work on Part I had commenced, which resulted in inordinate delay in the utilisation of irrigation supplies.

5.1.21 There is considerable loss of water due to seepage in unlined channels. It is possible to retrieve one third to one half of the seepage losses from channels through pumping and about 80 per cent of the losses by lining them. However, owing to financial and other constraints, it may not always be feasible to take up at one time lining of all the channels which may need the improvement and hence the work may have to be phased. In such a situation priority should be given as follows :

- (i) On new projects and projects being remodelled, channels, which are designed to run constantly or most of the time should be preferred because of the difficulty, and in some cases unfeasibility, of lining them later once they

are opened for irrigation.

- (ii) On existing projects, the smaller channels including water courses should be preferred. These lend themselves better to the spreading out of the programme of lining over a larger area and longer period.

5.1.22 There is also considerable loss due to evaporation from reservoirs, the extent of which varies from place to place and month to month. It is generally more in areas where water is most precious. Research on evaporation retarders should be intensified with newer materials and techniques in order to make the saving of water, economically worthwhile. This would be a suitable subject for a multidisciplinary research project sponsored Centrally.

5.1.23 There were about 5 lakh tanks in the country in 1950, most of them located in Andhra Pradesh, Karnataka, Orissa, Tamil Nadu and West Bengal. The net area irrigated by tanks remained steady at about 4.5 Mha from 1956. Many tanks are in a state of disrepair due to silting, breaches etc. In the case of Government tanks, annual maintenance grants often fall short of requirements. In Tamil Nadu a system of routine inspection of tanks called 'circle system' is followed under which every tank in the State is inspected once in 5 to 6 years and necessary repairs effected. Other States which have fairly large tank irrigation, may adopt the system with advantage. Where *panchayats* are responsible for the maintenance of tanks, they should raise sufficient financial resources for the purpose through water charges. In some parts as in Chota Nagpur region and Santhal Parganas of Bihar and Chhattisgarh region of Madhya Pradesh, although rights in resect of ex-Malgujar tanks vest in the Government, beneficiaries claim irrigation rights without paying water charges and without contributing to the maintenance and repair. There is need for a suitable legislation to remove this anomalous position.

5.1.24 The basic considerations in planning irrigation schemes have been the cropping pattern, intensity of irrigation and duty of water i.e. relation between the area irrigated and the availability of water required to irrigate it. In practice, once a project is constructed, there is hardly any enforcement of cropping pattern or irrigation intensities. Some changes in the pattern of irrigated cropping are warranted in several States for the enforcement of which the State Governments should assume necessary powers. While the adoption of high intensity of irrigation is obviously called for where the area is limited and water ample, a high intensity will not be justified where the available water can physically serve a larger commanded area, as the latter would benefit a few farmers and accentuate social

disparity in the farming community. The actual irrigation requirement in an area depends on several factors such as type of soil, climate, contribution from effective rainfall, crop types and their duration etc. As these vary from project to project, irrigation channels should be designed individually taking these factors into consideration instead of applying a uniform yardstick.

5.1.25 The operation of an irrigation system is governed mainly by the demands of the predominant crop. Factors like effective rainfall and the texture and depth of soil too have a bearing. The schedule of irrigation supplies should aim at meeting the various requirements of plant growth on time. If these cannot be met in full, the running of channels should conform to the more crucial stages of growth of the predominant crop.

5.1.26 In an irrigation system fed from a reservoir the quantity of water available for irrigation at the end of rainy season is generally known. It should, therefore, be possible to draw up a plan for the best use of this water, and a suitable schedule of running channels. The information regarding the extent of area under the more important crops for which water would be available and the tentative schedule of running channels should be widely made known to farmers so that they may plan their cropping and connected operations accordingly. The schedule of channel operation should be modified from time to time as the season advances to suit actual requirements.

Perspective of Irrigation Development

5.1.27 It is estimated that with the observance of the guidelines indicated in paragraph 5.1.16 it should be possible to ultimately irrigate about 110 Mha, that is 52 per cent of the gross sown area of 210 Mha.

5.1.28 There is wide disparity in the availability of water resources in different States. The percentage of gross area sown that can be ultimately irrigated ranges between 17 per cent in Himachal Pradesh and 85 per cent in Punjab. Statewise figures of area sown and those of area irrigated and the projections for the years 2000 and 2025 AD are given in Appendices 5.1 and 5.2. The quinquenniumwise phasing of gross irrigated area at the All India level is given below :

Year 1	Surface water 2	Ground water 3	Total 4
1950-51 ·	16	7	23
1968-69 ·	23	12	35

1	2	3	4
1973-74 :	26	16	42
1980	31	20	51
1985	36	25	61
1990	41	28	69
1995	46	31	77
2000	51	33	84
2005	56	35	91
2010	61	37	98
2015	65	38	103
2020	68	39	107
2025	70	40	110

Cropping in Irrigated Areas

5.1.29 The farmers' choice of irrigated crop depends primarily on consideration of the net income he can derive from it. But there are certain technological and economic considerations like the water requirements of crops, their productivity per unit of wateruse etc. which need to be taken into account in the interest of both the farmer and the nation. Rice commands the largest irrigated area and consumes 50 per cent of the irrigation water. Even so, amongst cereals it has the lowest productivity per unit of water. Considering the various factors that effect the performance of irrigated rice, it should be grown preferably where there is good support from rainfall on soils which have a permeability of 5 mm per day or less and in valleys where generally there is heavy soil. It may be grown in non-rainy season or low rainfall areas only if the available irrigation supplies cannot be put to more economic use for other crops. A number of crops can be grown under irrigation more profitably in low rainfall areas. They are mainly millets, pulses, soyabean, groundnut, sesamum and castor during kharif and wheat, oats, barley, pulses, sunflower, safflower, linseed and mustard during rabi. Crops in irrigated command are best chosen from amongst those which are natural to the area under rainfed conditions; and with irrigation support their yields increase and become assured. It is in this context that the consideration of agroclimatic zones assumes importance in planning irrigation projects.

5.1.30 Keeping in view the overall national needs, some adjustments in the general cropping pattern based on the rainfall pattern are called for. Rice is at present grown in several areas where there is inadequate rainfall, resulting in poor yields. These areas should best be changed over to other crops for better production. There is greater demand for more oilseeds, hence the area under these crops needs to be increased substantially. The area under fodder too must be increased substantially, if cattle are to be fed properly and the

breeds improved. The area under cotton needs to be stepped up to meet the growing requirements of cloth and a good proportion of it should be provided with irrigation. An analysis of the irrigated area projected for the future has revealed that replacement of rice with some other crops in some areas of Tamil Nadu and Andhra Pradesh is desirable from the point of view to higher production. The increasing requirement of rice can be met by bringing more of rice area under irrigation in regions where rainfall is fairly high for at least two months, needing irrigation support only for about a month. The entire wheat and sugarcane crops in course of time would be grown under irrigated conditions. Some marginal adjustments in cropping pattern in most States are called for, from the point of view of maximising production.

Drainage

5.1.31 Drainage is an integral part of an irrigation project without which the project would be incomplete and will not yield the best results. To be effective, drainage system should extend to field drains. For efficient drainage in irrigated areas, the nallas lower down should be kept clear of all obstructions. These natural waterways are apt to be encroached for illicit cultivation and blocked for lifting water for irrigation for catching fish. The responsibility for maintenance of these should be placed squarely on a single department. In most of the States this responsibility lies with the Irrigation Department. Irrigation Acts in some States empower Government to construct and maintain field and other drains and most States prohibit creation of obstructions in notified streams and drains. The States may review the position in this regard and assume adequate powers, where these are deficient.

5.1.32 There are numerous ponds, large and small, called '*chaurs*' or 'hoars' in the flat alluvial areas of Assam, West Bengal and North Bihar. In the command area of Kosi Project alone about 117,000 hectares are under *chaurs*. Some of these can be drained, reclaimed and brought under crops. There is, however, an alternative use for them, namely, pisciculture. In the summer months when '*chaurs*' shrink and tend to dry up, they can be replenished with canal water to the extent necessary to maintain fish. The canal water can be paid for as for irrigation. It may be pointed out that area for area, a pond can give as much income, if not more, from pisciculture as crops, and fish can supply protein of superior quality in which foodgrains are deficient. Therefore, before any scheme of dewatering a *chaur* is undertaken, the economics and feasibility of putting it under pisciculture should be examined.

Modernisation of Existing Irrigation Systems

5.1.33 Many of the older irrigation systems in the country, and even some of the more recent ones, do not meet the requirements of modern agriculture adequately and call for modernisation. With a view to getting an idea of the scope for improvement in existing irrigation projects, and evolving a methodology for such reviews covering engineering, water utilisation and agronomic aspects, five projects, (a) Badua (Bihar); (b) Ghod (Maharashtra); (c) Harsi (Madhya Pradesh); (d) Shetrunji (Gujarat) and Lower Bhavani (Tamil Nadu) were reviewed and an Interim Report on the subject was submitted in February 1973 recommending provision of adequate funds for the purpose in the Fifth Plan then under preparation. The Commission reiterates the recommendation that a comprehensive review of pre-plan and earlier plan projects should be undertaken by the States to formulate a programme for their improvement. It would be desirable to complete these reviews within the next five years so that these improvements are taken into account in preparation of river basin plans.

Economics and Financing of Irrigation Works

5.1.34 Before Independence, irrigation projects were required to satisfy the financial test of profitability for sanction. Certain protective irrigation works were, however, taken up in which case the financial test was relaxed. Many post-Independence schemes had storage dams and channels in undulating terrain. In consequence, they were more expensive and some of these did not measure up to the financial test. The Committee to Suggest Ways and Means of Improving the Financial Returns from Irrigation Projects (1964) recommended the adoption of the economic benefit criterion for sanctioning irrigation projects. The benefit cost ratio criterion has since been in use.

5.1.35 However, total water resources in the country being less than the requirements, all physically feasible projects will have to be taken up eventually. The benefit cost ratio, though an efficient criterion for determining whether a project is economically viable and paying, is not so good a criterion for ranking projects which have a benefit cost ratio of more than one. A suitable reworking of the benefit cost calculations can nevertheless give a more accurate ranking. One such method is the technique of internal rate of return and this being more satisfactory than the benefit cost ratio should be adopted in future. In making the economic appraisal, the cost of works and that of land shaping and construction of field channels and field drains should all be taken into consideration. The cost of soil con-

servation measures in the catchment, however, need not be taken into account from practical consideration.

5.1.36 Irrigation works, which were generally remunerative before Independence as well as multipurpose projects are showing losses now. The annual loss had risen to about Rs 141 crores in 1971-72. One important reason for the increasing losses was that irrigation rates did not keep pace with the rise in commodity prices; they remain, in fact, exceedingly low. The Irrigation Commission (1972) observed that canal rates in force for the two major irrigated crops viz. rice and wheat, ranged between 1.1 and 4.5 per cent of the value of the produce. Farmers arranging their own irrigation or purchasing water from neighbours incurred much higher expenditure. Therefore, the rates should be revised upwards. In fixing these rates, the overall consideration should be that, taken as a whole, irrigation works in a State should not impose any burden on the general revenues. On canal systems, where farmers are prone to speculate on rainfall to avoid paying irrigation charges, a two-part tariff comprising a cess intended to cover the maintenance cost of irrigation works to be paid by all farmers of the command and a water rate fixed cropwise should be adopted.

5.1.37 While irrigation is the responsibility of the State, paucity of funds has been coming in the way of progress of many projects, which has been sought to be removed by special Central assistance. In order to carry out construction of large projects at optimum pace, the Centre should provide additional outlays for them. The estimates of all irrigation projects planned should be reviewed and updated at least once in five years and in any case, before the formulation of a five year plan.

Irrigation Administration

5.1.38 Till October, 1974 minor irrigation including groundwater, water management, command area development and soil conservation were being dealt with in the Land and Water Wing of the Ministry of Agriculture, while irrigation used to be the concern of the Ministry of Irrigation and Power. In the Planning Commission, all these subjects were in the charge of the same Member from 1967. With the reorganisation of Ministries in October, 1974 irrigation was brought under the redesignated Ministry of Agriculture and Irrigation and the handling of the subjects rationalised by bringing them in the same Ministry.

5.1.39 Hydrological data are the very basis for a planned development of water resources. These, comprising river and stream flows, rainfall and groundwater observations, have to be available for

a fairly long period, say, 30 years, for making a reasonably dependable assessment of projects. At present these are dealt with at several levels and by several organisations. At the Centre, the India Meteorological Department (IMD), the Central Water Commission (CWC) and the Central Ground Water Board (CGWB) are the concerned organisations. In the States, the Irrigation Department and the State Ground Water Board are the main organisations that deal with the subject. Whatever data are collected in the States are mostly kept for their own use and some of them are not published at all.

5.1.40 Keeping in view the work being done by different organisations in the field of hydrology, the setting up of a separate Directorate of Hydrology, as proposed by the Irrigation Commission (1972) would not by itself overcome the difficulties encountered in this field. The CWC should be allowed to continue to perform its legitimate function of collecting, collating and publishing hydrological data and it should be adequately staffed and equipped for the purpose. The Government of India should take steps to make it obligatory on the part of the States to furnish the hydrological data, which they collect to the concerned Central organisations as may be required. With the IMD continuing to deal with precipitation, the CGWB handling groundwater in all its aspects, the proposed National Institute of Hydrology concerning itself with all hydrological research and the CWC collecting collating and analysing hydrological data and publishing the same, the organisational arrangements for hydrology at the Centre should be adequate. These organisations, however, have to be fully assisted to enable them to discharge their functions satisfactorily.

5.1.41 The Irrigation Commission (1972) had also proposed the setting up of River Basin Commissions by an Act of Parliament to prepare basin plans, deal with all aspects of water resource development and compile and analyse relevant hydrological and geohydrological and other groundwater data, and a National Water Resources Council at the highest level with the Prime Minister as the Chairman to lay down policies and suggest priorities in development. While supporting both these proposals, it is suggested that an eminent agricultural scientist may also be included as a member of the Council.

5.1.42 The River Basin Commissions should examine not only the best use of water resources within a basin but also the possible better use of part of the resources elsewhere, where the need may be great and the benefit considerable. Some interbasin transfer of water would be necessary for making the fullest and best use of the water resources of the country. The existing laws do not provide for interbasin transfers. Though such transfers are best arranged through

agreements and contracts, the possibility of disagreement cannot be ruled out. Whatever constitutional amendment is, therefore, necessary for enabling a nonbasin State to get water by transbasin diversion should be made.

5.1.43 A water resources accounting unit should be set up in the Irrigation Department of every State. This unit would keep a watch over the use of supplies from surface and groundwater sources for irrigation and various other uses like industrial needs, urban and rural water supply requirements etc. A water budget, with source-wise account of the potential, the proportion already being tapped and what remains to be exploited, helps to plan a balanced development of available water resources. Also there should be adequate arrangements for the flow of information to this unit from other water using departments.

Irrigation Research and Training

5.1.44 In the past couple of decades, research in the field of irrigation has tended to concentrate on material and hydraulic structures to the neglect of hydrology and water use. Some work on water use has been done under the ICAR and in some other research stations and institutions but a lot more needs to be done. In the future programme of research more attention should be paid to the following items :

- (i) snow gauging and contribution from glaciers;
- (ii) effect of soil conservation measures and change in land use on runoff and infiltration;
- (iii) hydrological investigations and assessment techniques of groundwater in hard rock areas;
- (iv) reduction in evaporation from reservoirs;
- (v) lining materials and techniques;
- (vi) optimum size and spacing of field drains;
- (vii) reduction in yield due to root submergence for different length of time during different periods of growth for crops;
- (viii) effect on yield of the number and timing of irrigation for other crops, besides wheat; and
- (ix) water pollution due to use of fertilisers and pesticides and discharge of industrial effluents into streams.

5.1.45 The irrigation engineer is basically a hydraulic and structural engineer. He should have some knowledge of agriculture to be effectively in command of irrigation projects. Essential elements of agriculture should, therefore, be included in the syllabus for engineers.

On joining service, they should be given training in agriculture for some time at an agricultural university as also in revenue matters in the Revenue Department. Also in-service training courses should be organised for them at suitable intervals.

2 COMMAND AREA DEVELOPMENT

5.2.1 In the pre-Independence irrigation projects, Governmental responsibility was generally limited to the maintenance of head works, canals and distributaries, leaving actual utilisation of water to farmers. This overlooked some major field problems which in course of time, raised serious hurdles in utilising the irrigation potential created. Quite unlike the early works, which benefited the plains and the delta areas, most of the new projects commanded uneven and difficult terrain. Experience of administering some of the latter projects showed that unless irrigation development was carefully planned and certain pre-requisites provided in command areas, neither the potential created would be fully or expeditiously utilised nor agriculture modernised with speed.

Soil and Soil Surveys

5.2.2 Questions like suitability of an area for irrigation and intensity of irrigation can be decided, taking into consideration the type and characteristics of predominant soils. Soil mapping is, therefore, one of the first step to be taken. While soil samples taken for every thousand hectares would be enough for the purpose of project formulation, a more intensive survey based on larger samples at the rate of one per 50 hectares of command area would be required for determining cropping pattern etc. and planning agricultural improvements. Once irrigation has been arranged, a much more detailed soil survey covering every operational holding in the command is called for to determine the kind and quantity of fertilisers and soil amendments that need to be applied.

Land Preparation for Irrigation

5.2.3 For land development in command areas, a number of steps are required to be taken in an integrated manner. These comprise :

- (i) layout of plots and of common facilities like water courses, field channels, drains and farm roads;
- (ii) consolidation of farmers' scattered plots into one or two operational holdings;

- (iii) construction of watercourses and field channels;
- (iv) construction of field drains where necessary and linking them with connecting drains;
- (v) provision of farm roads; and
- (vi) land formation to suitable slopes.

5.2.4 All these steps have to be taken in a systematic manner. The first step would be to prepare layout plans and designs on suitable maps and mark out plots and features. The area commanded by a single outlet should be considered as the basic unit for this exercise. Common facilities should be planned in such a way that every field has independent access to them. Topographical maps for the purpose have to be detailed and drawn to the scale of 1 : 2,500 or 1 : 4,000 with 10 cm contour interval. In addition, soil and land classification maps of the area will also be required.

5.2.5 Depending on the slope of the land, crops to be raised, water holding capacity of soils and extent and nature of irrigation available, the mode of irrigation has to be decided, i.e. whether it should be flood irrigation, furrow irrigation, sprinkler irrigation, drip irrigation or any other kind. It may be necessary to use more than one method in some fields. One aspect which has remained generally neglected in irrigation projects is drainage. Experiments have shown that submergence of fields by irrigation water or storm water results in lower yields. For efficient crop it is important that farmers have complete control on irrigation, which will be possible only if field drains are systematically laid. Land levelling and formation of the command area is equally important. It is more so in most of the new works which command uneven and slopy terrain. Land preparation for irrigation on such fields becomes expensive and could even be prohibitive.

5.2.6 Consolidation of holdings, as it facilitates proper layout of water courses, field channels, drains and roads and relaying of fields to proper length and width according to natural slope, is considered a prerequisite to command area development. Certain measures envisaged under the land reforms, such as enforcement of land ceilings, allotment of surplus land etc., can also be undertaken at the same time. It is desirable that small holdings are grouped in contiguous areas and located at the beginning of water courses to facilitate equitable distribution of water. Consolidation of holdings by itself confers a great deal of benefits to farmers in the shape of increased production.

Preparation of Command Area Development Report

5.2.7 The contents of Part I of the project report have already

been indicated in the preceding section. As for Parts II and III, the former should cover all engineering works in the command area, like land levelling and shaping, construction of water courses, field channels, drains and roads, while the latter should be devoted to all aspects of agricultural development and supporting facilities in the area. Since, like Part I, items figuring in Part II are of the nature of engineering works, the responsibility for preparing the part should also be placed on the Irrigation Department. As the work is not handled by the Department at present, it should organise a special set up for the purpose.

5.2.8 A number of departments like those of Agriculture, Animal Husbandry, Forests, Fisheries and Cooperation are involved in the preparation of Part III. Each department should make a careful assessment of the current situation in the area of its responsibility, examine the scope for improvement made possible by irrigation and indicate the requirements of inputs, credit, infrastructural needs etc. to realise the anticipated benefits. It would be necessary to create a planning cell in each of the departments for undertaking this work. These cells should pass on the details to the Irrigation Department which would prepare the comprehensive report for sanction. Thus, whereas Parts I and II are intended to be operative on sanction of a project, Part III is intended to indicate the development programmes that need to be carried out in other connected fields of agriculture in the command area. Since an irrigation project does not merely consist of works designed to supply irrigation water but also encompasses all connected measures for the proper utilisation of water, the guidelines issued by the Planning Commission in March, 1974 for the preparation of project reports should be modified in the light of these recommendations.

Prospective of Command Area Development

5.2.9 The timely and proper implementation of land formation programmes in command areas is crucial to the success of other measures of development as well as the production programme. Several stages of land formation work have to be taken up simultaneously and the consolidation procedures modified to speed up the work. To avoid any undue lag in the utilisation of irrigation supplies, this work should be taken up concurrently with the construction of irrigation channels.

5.2.10 The extent of area in the existing major and medium projects, at present, awaiting land formation work including that where irrigation supplies would become available in the next two to three years is of the order of 10 Mha. The land formation work would need to

be completed in about 30 Mha by 2000 AD and 49 Mha by 2025. The current pace of the programme of work needs to be stepped up to 1 Mha per annum by 1980 and 1.4 Mha by 1985, if the backlog has to be almost cleared by 2000 AD. The main constraints would be both organisational and financial, which should be given immediate and serious attention. Proper land formation is equally important in the commands of minor irrigation projects. There would be 9 Mha by 2000 AD that would require action.

Organisation

5.2.11 An ideal organisational set up for command area development has been under consideration for a long time. Tungabhadra was one of the new major projects where irrigation faced serious challenges from land and soils, and for the solution of which special organisational measures were taken. The Divisional Commissioner of the area was concurrently appointed as Administrator to supervise and coordinate the activities of the concerned departments. Kosi was another project where similar steps were taken. A different organisation was tried in Nagarjunasagar with a view to attempting something more than ensuring coordination. A senior engineer was appointed Special Secretary in the Irrigation Department who headed the Development Committee of the Project. He was given the powers of "Head of Department" of all departments involved in command area development. Under him, a team of officers drawn from key departments was formed which toured the area and took on-the-spot decisions and steps to hasten the tempo of irrigation utilisation. During the Fourth Plan, 14 projects were taken up for the command area development. The progress, however, has been rather slow. The problem in general was one of affecting coordination which was sought to be achieved by appointing a senior officer. There was, however, no attempt to set up a separate organisation for the purpose.

5.2.12 In 1973, the Central Government recommended to the States the creation of a Command Area Development Authority (CADA) for every large project or groups of small projects, with an Administrator as its head and an Inter-departmental Committee with the Chief Minister as Chairman, to keep under constant review problems relating to the optimum utilisation of irrigation. Also, it was recommended that there should be a Water Utilisation and Command Area Development Department, headed by a Secretary enjoying the status of Additional Agricultural Production Commissioner. He would be ex-officio Secretary in the Departments of Agriculture, Revenue Cooperation, Forest, PWD, Irrigation, Planning and Finance in respect of the area command development work. Substantial finan-

cial support to the proposal was promised to the States. The set-up proposed marked a major change from the existing one and reflected the Centre's concern for speeding up irrigation development.

5.2.13 In the Fifth Plan, 51 projects have been proposed to be brought under CADA. By April, 1975, CADAs have been created for 31 of them. The structure and organisation of these authorities, however, varied from State to State. The organisation, as conceived, cuts across the established hierarchy and is intended to reduce delays and ensure better coordination.

5.2.14 The Command Area Development Authority, as envisaged, is burdened with numerous responsibilities and extensive powers. As more and more area is brought under the CADAs, the departmental jurisdiction would shrink and the normal pattern of the concerned developmental departments would be disrupted. The arrangement for command area development through CADA, though expedient as a short term measure, may not be quite suitable as a pattern for the future. In Chapter 14, the appointment of a Chief Agricultural Development Officer (CADO) at the district level has been recommended. His main functions would be to secure coordination between extension service, supply of inputs, credit, marketing and similar supporting activities and to liaise with other development departments such as Irrigation, PWD, Panchayati Raj etc. and autonomous bodies and private organisations active in the field of agriculture. In districts where part of the area is under a CADA and part under a CADO, this in itself will create problems of coordination in planning, progress reporting, evaluation, extension work and supply of inputs for the district as a whole. In such cases, it is desirable that the CADO should have jurisdiction over the entire district including the command area.

5.2.15 Development work in command areas consists mainly of land development, and arranging inputs, extension and other services. While the latter is a continuous job and can be handled effectively by normal departmental agencies, the former is a one-time job which can best be done by a specialised organisation. It can also be moved from one command to another on completion of the job. The work involved is mainly land grading and shaping and construction of water courses, field channels field drains, farm roads etc. which require a degree of engineering skill. These works will have to be carefully coordinated with construction of distributaries and minors. Hence the overall responsibility of field work should be with the Irrigation Department.

5.2.16 Land levelling and shaping is the most expensive part of land development for which farmers would need loan assistance from institutional sources. The organisation for the purpose should

be such as can avail of such credit. For this reason, the land development work is best entrusted to a Land Development Corporation and not to any Government department. The Corporation should have its own staff and equipment and should be vested with necessary authority to discharge its functions. At the secretariat level, the Corporation should be the responsibility of the Irrigation Department. In some States, agro-industries corporations have taken up land levelling work. Since it has to be done along with the construction of water courses, field channels, field drains and farm roads as a single operation, the agro-industries corporations are not the best agency for this work. Similarly, the State soil conservation organisation should not be entrusted with land preparation, as has been done in the case of some projects.

5.2.17 Since the work of consolidation of holdings is inseparable from the preparation of proper layout plans, the main burden of consolidation work has to fall on the Land Development Corporation. It should have special staff for the purpose, either especially trained or borrowed from the Revenue Department. There should be a legal provision that once it is decided to undertake land formation operation in a command area, consolidation of holdings should be obligatory. This might be carried out with people's cooperation. As this work can be delayed if revenue records are not up to date, timely steps should be taken to update the land records deploying special revenue staff for the purpose, if necessary. During the period the land formation operations are in progress, which may extend over 2 to 3 years, interim cropping patterns may have to be adopted and special arrangements made for supply of seeds and other inputs. A project Development Officer should be placed in overall charge so that the various activities in the command area get properly coordinated. As soon as the development work is completed, the area should revert to normal organisational arrangement under the overall charge of the CADO.

5.2.18 If the land development programme is to move fast, it will be necessary to map over a million hectares of command area every year. The magnitude of the task requires that more sophisticated techniques of mapping are adopted. There is adequate potential available in the country for carrying out aerial photography for the preparation of maps. But the present capacity for preparing maps by photogramatic process is limited to about 50,000 hectares per annum, which needs augmentation. Although the mapping work of command areas has been undertaken in the past by the Survey of India, the command area work often tended to receive lower priority due to pressure of normal as well as priority work of that organisation. Hence it would be advisable to have a

separate Land Survey and Mapping Corporation exclusively for command area mapping under the same Ministry which administers the Survey of India. Alternatively, a separate wing may be created in the Survey of India, called Command Area Mapping Wing for handling this work. Aerial photographs and most of the maps are at present treated as restricted for security reasons and not made available even to Government departments for planning developmental work. It is necessary that these restrictions are relaxed to the maximum extent possible.

Economics and Financing

5.2.19 Land grading and land shaping in command areas constitute a costly investment, the burden of which falls on the farmer. For a variety of reasons like inadequacy of finance, paucity of technical know how and lack of appreciation of possible economic benefits, this aspect has generally remained neglected. It is estimated that the proper land levelling can save 15 to 20 per cent of water which can be utilised for irrigating more area besides facilitating efficient drainage. Pilot studies in some command areas on benefit cost aspects of water management techniques involving land levelling show that considerable economic benefits accrue to farmers as a result.

5.2.20 The Land Development Corporation should carry out the work of land formation on behalf of and at the cost of farmers. It, however, needs adequate funds for undertaking the work. The funds for carrying out the work have to come from institutional sources as long term loan.

5.2.21 There is much to be said in favour of farmers getting all their credit from a single source. Farmers' Service Societies (FSS) are being set up to provide integrated agricultural credit service primarily to small and marginal farmers and agricultural labourers. In command areas about a quarter of the area is operated by small and marginal farmers. It would be desirable that these weaker sections get all their credit requirements, short, medium or long term, from these societies which will need to be provided with sufficient credit to enable them to cater to requirements of land development in command areas.

5.2.22 The Land Development Corporation should estimate credit requirements of each farmer in the command area for undertaking the land development work. On the basis of this requirement it should approach the commercial bank operating in the area for accommodation possibly to the extent of 50 per cent to total requirements to enable it to start the field work. While this amount would be debited to the FSS, it will actually be made over to the Corpora-

tion. On completion of the work, necessary adjustments in the credit account of each farmer will be made. The amount advanced to the Corporation by the commercial bank would get finally debited to the farmer's account and the Corporation cleared of its liability. The Corporation should try to complete the job as quickly as possible by organising field work for maximum number of days in a year, and should not merely confine to off season periods. This would help reduce overall cost. Since farmers will not be able to grow crops during the period when work is in progress, they will have to be given a sustenance loan which should be considered as part of long term loan repayable in instalments.

5.2.23 Long term loan is generally advanced against the security of land or where there is no viable asset, under a Governmental guarantee. It is, therefore, necessary that the title of farmers including that of tenants and share croppers to land is recorded clearly. Even before consolidation of holdings is undertaken, it would be necessary to enforce land ceiling so that the allottees of surplus lands assume responsibility for land development and also become entitled to credit. The burden of developing share cropped lands should be shared between the land owner and the share cropper. While farmers with clear title to land and willing to take loan for land development pose no problem, there will be some who are reluctant for some reason or unable to take loans for want of clear title to land. Since no part of irrigable land in a command area can be left out of the scope of developmental operations, the government should provide necessary funds in respect of unwilling farmers for completing this work and then recover the amount as arrears of land revenue. For the farmers who are willing but unable to take loans for want of clear title and have the capacity to repay, credit should be extended under a Governmental guarantee.

5.2.24 The commercial banks and the Agricultural Refinance and Development Corporation (ARDC) which extend credit for land development work would like to satisfy themselves about the economic soundness of the proposal sponsored by the Land Development Corporation before they advance credit. To avoid unnecessary delays, it is desirable that the feasibility appraisal is done by the ARDC, which is the ultimate source of finance for the purpose, instead of individual banks and then by the ARDC. It would also be desirable to appoint a representative of the ARDC on the Board of Directors of the Land Development Corporation so as to ensure better rapport between the two and facilitate expeditious processing of the scheme for loans.

5.2.25 The Draft Fifth Plan makes a provision of Rs. 216 crores for command area development, to be shared between the Centre

and the State. While this should meet the financial requirements for organisational purposes like establishment of CADAs, Water Utilisation and Command Area Development Departments, topographical and soil surveys etc, it does not cater to actual land development work, the funds for which have to come from institutional sources. The annual credit requirement for the purpose by 1980 is estimated at Rs 120 to Rs 150 crores annually, which would further increase to Rs 170-210 crores per annum by 1985. One fourth of this amount would be needed by small and marginal farmers, who are also entitled for a subsidy which needs to be provided from plan sources. The full requirement of financing command area development from institutional sources along with the contribution of Governmental sources must be made available to maintain the stipulated pace of development. Any shortfall in this respect would result in corresponding nonutilisation of irrigation potential. It is equally important that steps are taken in advance to strengthen commercial banks functioning in the area, and to organise farmers' service societies, to cope with the credit needs of land development work.

5.2.26 Besides, it is necessary to take steps to prepare farmers for irrigated farming. While they need to be trained in water management and appropriate tillage practices, adaptive research should be organised to determine the appropriate cropping pattern and more suitable varieties of crops. To subserve this purpose, experimental farms should be established in the area well before irrigation supplies become available. Steps are also required to train farmers in judicious use of irrigation water whether he gets the supplies during day time or night. The introduction of warabandi system practised in north India can go a long way not only to ensure more efficient use of irrigation supplies by farmers but also to protect the interests of weaker farmers who, in the absence of such arrangements, may be deprived of their due share during periods of keen demand.

3 LAND RECLAMATION AND DEVELOPMENT

5.3.1 There are large areas in the country which remain uncultivated but can be reclaimed. These mainly comprise (a) waterlogged lands; (b) lands affected by salinity and alkali; (c) lands infested with shrubs and bushes; (d) ravines; and (e) riverine lands. Besides, there are stretches of coastal sandy lands, stony and gravelly lands and lateritic soils with thin soil cover which too remain unutilised. On the other hand, the demand for land has been increasing very fast. Reclamation and development of these lands have become possible with the availability of newer technology. While the cost of recla-

mation depends on the nature and extent of deterioration, benefit depends on the level of productivity of land and the extent to which the causes of deterioration are eliminated and the inherent fertility is enhanced and sustained. Finally, benefit cost ratio determines the feasibility or otherwise of the reclamation methods.

Magnitude and Causes of Soil Deterioration and Methods of Reclamation

5.3.2 Waterlogging occurs mainly as a result of obstruction to natural drainage, created by roads, railways, canals, aerodromes townships etc. Irrigation without proper drainage also leads to waterlogging. The total area affected by waterlogging in the country is estimated at about 6 Mha; of this 3.4 Mha are subject to surface flooding and the remaining 2.6 Mha have a high water table. Experience of the past 70 to 80 years in the Indo-Gangetic plains suggests a few effective remedies such as drainage to remove surplus water; lining of canals to prevent seepage; and sinking of tubewells for lowering water table. Plot studies made in Punjab and Haryana in the sixties to determine the most effective methods of reclamation revealed that a combination of measures such as drains and tubewells can effectively eradicate waterlogging. Drainage water is generally fit for irrigation and every effort should be made to utilise the same for the purpose. There would still be some areas remaining waterlogged and liable to flooding. These areas should be brought under suitable crops, taking care to avoid the flood season.

5.3.3 Saline and alkali soils occur quite extensively in almost all climatic zones. The extent of area affected is roughly 7 Mha. Salt affliction in soils may occur due to a variety of causes like capillary rise from subsoil bed of salts; indiscriminate use of canal waters; salt impregnated sand being blown in by sea wind; decomposition of soil material; and ingress of sea water. Climate, geology, topography and hydrology, play either singly or in combination, important part in determining the salt regime of a tract.

5.3.4 No systematic attempt has been made to delineate the area affected by salinity and alkali separately. Genetically, the saline soils are the parent materials from which alkali soil originate. It is important to delineate these soils separately because reclamation methods differ. Detailed mapping should, therefore, be initiated in areas where reclamation projects are being launched.

5.3.5 The superiority of gypsum as the cheapest amendment for reclamation of saline-alkali and alkali soils has been well established.

Methods are also known to estimate gypsum requirements of soils for field application. However, gypsum treatment alone is not enough. It has to be supplemented with proper crop rotation, post reclamation agronomy and irrigation. Gypsum is available in the country in adequate quantities and several million tonnes of it can be mined from Rajasthan quarry alone. The cost of agricultural grade gypsum varies from Rs 15 to Rs 18 per tonne at the quarry site. However, the major components of cost are grinding, transport and packing. Taking all these factors into account, sale price in bulk may be around Rs 70 per tonne. Though this price is not prohibitive considering the benefits expected from reclamation there is justification for a suitable subsidy to small and marginal farmers on purchase of gypsum for reclamation. It would also be expedient to take up large scale reclamation projects in order to prevent intrusion of salts from neighbouring areas. During the reclamation, changes in physio-chemical characteristics of soil have to be periodically observed to enable modification of measures.

5.3.6 Sizable areas are under shrubs and bushes in States like Uttar Pradesh, Bihar, Madhya Pradesh and Karnataka. The main reasons for such lands remaining unutilised are deep rooted grasses and weeds, lack of drainage, salinity and alkali conditions, severe erosion etc. Appropriate technology is now available to establish range lands or fuel/fodder reserves in such lands. Pilot operational research projects on watershed basis covering 2,000 to 3,000 ha may be taken up to test the economic feasibility of such measures. Standard soil survey should be carried out to delineate different land capability classes suitable for crops, grasses or forest plantations.

5.3.7 Extensive degeneration of land into deep gullies has occurred in some States, particularly in Uttar Pradesh, Madhya Pradesh, Rajasthan and Gujarat along the banks of rivers flowing in north central direction viz. the Yamuna, the Chambal, the Mahi, the Sabarmati and their tributaries. Indiscriminate use of land leading to disturbance of the ecology has been one of the reasons for this degradation. Over 3.67 Mha are considered affected by ravines. The problem of ravines has assumed urgency because they are fast spreading into cultivated lands. The other problem is the menace of dacoits in these areas. The production potential of foodgrains in ravine areas, when reclaimed, is very sizable. In addition, fruits, fodder, fuel, timber and raw materials can also be produced. On a conservative estimate the country is losing a total output worth about Rs 157 crores annually by failure to reclaim and develop the ravines.

5.3.8 The estimate of ravine lands is not based on any systematic survey; as such there is urgent need to carry out soil surveys in these

areas for the purpose of differentiation of various soils. For whatever areas aerial photographs are available, they should be interpreted to find out the physical features characterising a ravine system. For those areas for which aerial photographs do not exist, urgent steps should be taken to have them.

5.3.9 Experience with ravine reclamation projects so far attempted has shown that it is of utmost importance to subdue the effect of runoff in the watersheds of various ravines. Unless the whole of the watershed is treated including the ravine from the gully head to the bottom, isolated works would be in danger of being washed away. Since land ownership boundaries are likely to come in the way of scientific planning of ravine reclamation, it is desirable that land consolidation and settlement operations are undertaken simultaneously. Areas considered suitable for horticultural purposes should be planned on contours, and those recommended for forestry should be subjected to runoff management.

5.3.10 In 1967, the Government of India constituted a Central Ravine Reclamation Board to ensure ravine control on proper lines and a more rapid development of such areas. The national policy on reclamation of ravine lands consisted of two broad objectives, namely, to arrest further spread of ravines and to utilise already reclaimed lands for productive purposes, whether for cultivation of crops or grasses, horticulture or forestry. The economic benefits should not be the sole consideration in the reclamation of ravines. Poverty and the objective of curbing the activities of antisocial elements should receive due consideration. As such, ravine reclamation should receive national priority and investment should not be denied on account of narrow or unfavourable benefit cost considerations.

5.3.11 Heavy sediment load carried by rivers and their meandering action gradually give rise to formation of land masses on the course of rivers. About 1.5 Mha and 0.5 Mha of such lands occur in the river beds of Uttar Pradesh and Bihar respectively. An effective remedy would be that in multiple channel rivers occupying vast areas under their beds, subsidiary channels could be diverted, wherever feasible, into the main river and land under the bed reclaimed for profitable use. In the case of river, on which dams have been constructed to effect flood moderation, the canalisation for reclamation may be effected downstream of the dam.

5.3.12 Hill torrents or *chos* emanating from the Shiwalik Hills cover large areas under cultivation with coarse debris, sand etc rendering them uncultivable. Some efforts have been made to canalise and train the torrents around Hoshiarpur. The technique and experience already available in the field should be adopted extensively for training

torrents and reclaiming devastated lands.

5.3.13 There are large areas around the coastal line, part of them under sand dunes and part saline and hence unutilised. Experience in Tamil Nadu shows that plantations of casuarina on the sandy fore-shore backed by coconut, cashew, and eucalyptus further inland can effectively contain the problem of sand dunes. These plantations will also help reclaiming about half of the coastal area that is partly saline.

5.3.14 Erosion problem is also serious in stony and gravelly lands subject to heavy grazing, lateritic soils and in high altitude steep slopes and meadows. Stony and gravelly lands should be closed to grazing for a few years to establish good vegetative cover before controlled grazing could be permitted. Intensive research and development programme should be taken up for evolving rational land utilisation and obtaining economic production from shallow laterite soils through establishment of orchards of certain fruit trees, plantations of quick growing fuel species, pasture and grassland. Urgent measures should also be taken to put steep slopes in the Himalayas' watersheds under permanent vegetation and grasses to prevent soil erosion.

Review of Wasteland Reclamation and Utilisation

5.3.15 The problem of reclamation and utilisation of wastelands is complex, and the strategy should be based on the causes of origin. Wastelands, if properly developed, can supply fodder for cattle, fuel for villagers and raw materials for industries. Conservation and development of wastelands require close cooperation amongst the State Forest and Revenue Departments and the local community. The first step, however, would be to examine the causes which contribute to the emergence of wastelands and formulate schemes for their development.

5.3.16 The Wasteland Survey and Reclamation Committee appointed in 1959 to assess the extent of "other uncultivated lands excluding fallow lands" and "fallow lands other than current fallows" and to locate blocks of more than 100 ha of such land for reclamation and development, demarcated 641 thousand hectares of such lands in 12 States. More than half the area was concentrated in Punjab (including Haryana), Uttar Pradesh and Madhya Pradesh. A Centrally sponsored scheme taken up in August, 1971 for surveying wastelands, which were in blocks of 5 ha and above but less than 100 hectares, put the extent of area in such blocks in different States at about 2.3 Mha. The objective of these surveys was to locate wastelands and find suitable uses for them. To serve the purpose, they must provide the necessary information including categorisation of waste-

lands according to feasibility of reclamation. The categorisation of all wastelands in blocks of less than 100 ha should be completed as a Centrally sponsored scheme on a priority basis. The use of aerial photographs and remote sensing techniques may be adopted for the survey. Interpretation of aerial photographs and soil survey reports should be done on a uniform basis. During the surveys, data on water table should be collected and compiled since these data would help in better economic utilisation of land. Similarly, lands lying unutilised or underutilised along railway lines, national highways, rivers, canals, etc should also be surveyed, reclaimed and utilised according to land use capability. Steps should be taken to improve the soil fertility of such lands.

5.3.17 Wastelands which belong to Government are allotted mostly to landless agricultural labourers and ex-servicemen who have the necessary background in agriculture. These people, however, do not have the financial resources for undertaking reclamation. Therefore, provision for necessary inputs and credit to help them to undertake reclamation work as also cultivation should be made by the Government.

5.3.18 Afforestation with fast growing species of plants and trees can be helpful in converting large areas of waste lands into economic use. In the early stages of development of watersheds, afforestation may be considered as a protective measure rather than a financial proposition. There is an urgent need in the country for attaining self-sufficiency in fodder, fuel, small timber and soft wood for pulp. In this context, wastelands or unutilised lands offer great scope. Reclamation of wastelands may be planned to meet the above demands of national importance.

5.3.19 Development of pastures in wastelands can help to promote livestock industry. The carrying capacity of grasslands can be increased by developing pastures sown with high yielding grass species. In wastelands not suitable for soil working and sowing of high yielding grasses, fodder resources can be developed. To enable the livestock industry to develop faster in hilly and desert areas, development of pastures should receive greater attention.

Proposals for the Future

5.3.20 Each category of wastelands has its peculiar problems and special approach to reclamation. For each type of wasteland there has to be a considered programme of reclamation which will gradually build up soil and ultimately bring the land back to continuous productive use. The process may be long requiring lot of effort and capital

investment. Though from time to time a census of wastelands has been attempted, the magnitude of the problem has still got to be established in many States. There is need for a rapid survey of the position and systematic action to bring wastelands into productive use in the best possible scientific manner.

5.3.21 Efforts should be intensified to bring substantial portion of land infested with shrubs and bushes under fuel and small timber plantations for meeting the needs of expanding rural and semiurban population. The type of trees to be grown will depend upon expert's judgment as to the species which will be best suited to the agroclimatic conditions of the area. A lot of information in this regard is available with silviculturists and forest research institutes which needs to be updated on a continuing basis. Some of these lands can also be developed into fodder reserves or range lands for livestock raising, particularly to support intensive programmes of cattle and sheep development.

5.3.22 The recommendations made on sand dune reclamation and stabilisation in the Interim Report on Desert Development are reiterated. Stabilisation of sand dunes will be a part of desert development and will have to be done from the canal areas outwards. Wind breaks and shelter belts have also been recommended to prevent further encroachment by sand dunes.

5.3.23 Waterlogged lands contiguous to the sea coast have brackish water. They could be reclaimed either for cultivation or pisciculture. Research has shown that the most profitable use of these brackish areas is to develop controlled tank fisheries for prawns, bhekti, milk, fish etc. Similarly, areas affected by fresh water can also be brought under cultivation or put to pisciculture. Certain trees, grasses and hedges can also be grown on waterlogged areas.

5.3.24 Large scale reclamation of saline sodic soils has been programmed on the basis of research done at the Central Soil Salinity Research Institute (CSSRI), Karnal. There is, however, need to try alternative and less expensive methods of reclamation like raising suitable grasses and economic forest species. Operational pilot research projects should be taken up on contiguous problem areas of about 1,000 to 2,000 ha with a view to evaluating the economic feasibility of the practices under alternative land use. Possibility of composite fish culture in dugout ponds in the salt affected lands may also be investigated.

5.3.25 Reclamation of *cho* devastated areas has been taken up in Punjab. The Soil Conservation Research Centre at Dehra Dun has also undertaken studies on the problem. A more important result obtained related to the economic utilisation of bouldery and abandoned *cho* beds by means of fuel/fodder plantations. There is a

further need to improve the design and specifications of structures for canalising the *chos*.

5.3.26 Attempt has been made to reclaim sandy coastal areas with three lines of wind breaks, casuarina along the front line, cashew plantations as a second line and coconut plantations in the rear, with great success. Large scale reclamation of coastal tracts along these lines is suggested. Rocky stone and hilly areas with skeletal soil are not considered suitable for agriculture and forestry but can be developed for recreation purposes and nature reserves. Research work should be initiated to identify proper grass species suitable for wastelands occupied by shallow lateritic soils and to develop a technology for increased production from such lands.

5.3.27 Research work leading to increased agricultural production and for development of alpine pastures and meadows at high altitude locations needs to be intensified and should be taken up by the Indian Grassland and Fodder Research Institute, Jhansi. Further, the Himalayan watersheds being very important for the most fertile Indo-Gangetic plains, the ICAR should initiate watershed research on soil conservation and proper land utilisation with a view to rationalising land use practices for watershed protection and reduction of silt discharge.

5.3.28 Shifting cultivation being practised in tribal areas has been leading to rapid soil erosion and other damages like land slides in heavy rainfall areas. It is necessary to develop these areas with a production programme which, while preserving soil, will gradually improve the economic conditions of the inhabitants who are mainly tribals. The rehabilitation may be attempted in one or more of the following ways :

- (i) reclaiming land and providing irrigation, other inputs and services so as to encourage settled cultivation;
- (ii) identifying areas suitable for plantation crops;
- (iii) developing grass reserves to support animal husbandry programmes; and
- (iv) developing areas for agrosilvicultural operations and commercial forest plantations.

5.3.29 The area lying unutilised in the country and awaiting reclamation for better and productive land use is about 58 Mha or more. The approach to reclamation of different types of wastelands is different and so will be the financial implications. In the Interim Report on Desert Development, the total cost of desert development was estimated at Rs. 932 crores, of which Rs. 91 crores were earmarked for land reclamation. The Working Group on Ravine Reclamation Programme for Uttar Pradesh, Madhya Pradesh and Rajasthan recommended a seven year programme of reclamation of ravine

lands, estimated to cost Rs 94.5 crores for each State. An estimate made for the country as a whole, taking into consideration all kinds of lands affected by various erosion hazards and their development, places the total anticipated outlay at about Rs 23,000 crores to be incurred over a period of 30 years or more. These estimates give a broad picture of the order of investment involved in tackling the problem of reclamation.

5.3.30 Most of the land reclamation programmes are substantially based on irrigation extension and irrigation control. Ordinarily, irrigation facilities have to precede reclamation measures. Thus, phasing of reclamation work has to be related to the phasing of irrigation development. As reclamation will have to be done after the irrigation system materialises, it is reasonable to phase the reclamation programme over a period exceeding 50 years. Land reclamation should mainly be done through institutional investments availed of by beneficiaries. Alternatively, it may be possible for the State land reclamation organisation to take up advance reclamation of some areas every year and then distribute the same at a fair price to settlers. The land reclamation programme should be attempted on either of these basis so that direct investment by the State is limited and substantial investment comes from the farmers themselves through borrowing from institutional sources. While undertaking reclamation, it is important that social costs and benefits are kept in view and not merely the economic costs and benefits. Only then can a large scale programme, as is envisaged, can be implemented within a reasonable time frame. According to the principles of growth with social justice, marginal farmers and landless labourers will have to be brought within a reasonable production programme by inducting them on the lands which have been reclaimed.

5.3.31 Land reclamation should form a part of area development and would not require any separate organisation. The Central planning division will have to formulate the overall national programme with the help of State planning units, keeping in view the relative needs of the States for land, the needs of growth with social justice in backward regions and funds available from State and institutional sources. While land reclamation will require the help of tractors and machinery, exploitation of reclaimed areas would need substantial services and input supplies. All these will have to be arranged as part of the work of area development authorities.

5.3.32 As land reclamation problems are likely to vary from area to area, depending on the agroclimatic conditions, agricultural universities should provide scientific guidance and investigational support in all problems that may arise locally as the programmes make headway.

4 SOIL AND MOISTURE CONSERVATION

5.4.1 Soil and water are two very important natural resources not only for the existence of life *per se* but also for sustenance of natural vegetation which in turn help to conserve them. This mutual interaction gives rise to an ecological balance in nature. Increasing pressure of population on land has, however, been causing wanton denudation of vegetative cover which in turn has been leading to a steady loss of soil and water. Soil conservation has been conceived as a process of preventing such losses by adoption of antierosion measures. The concept of soil conservation has, however, broadened with time to meet the requirements of efficient and productive use of land.

5.4.2 Development of water resources is intimately linked with watershed management. Proper management of watershed requires that water yield is maintained unimpaired and optimum land use and sustained productivity are ensured. Conservation measures and soil and crop management practices should be such that loss of soil and soil moisture is minimised. Soil and moisture conservation in a watershed has, therefore, two aspects, viz. their conservation in the catchment of river valley projects and in cultivated areas. Conservation measures in catchment areas are aimed at saving the soil by keeping it under optimum vegetative cover and prolonging life of storage reservoirs by reducing siltation. In cultivated lands conservation problems are concerned with different types of conservation measures and their efficacy, agronomic practices, economics and other aspects.

Problem and its Magnitude

5.4.3 The land use pattern of a country broadly reflects the problem of soil and moisture conservation. Forests cover 21.6 per cent of the reporting area in India. A substantial extent of it has been depleted due to overexploitation and uncontrolled grazing and is either eroded or prone to erosion.

5.4.4 Shifting cultivation practised in some hilly areas, particularly in the north eastern parts has resulted in serious damage to soil resources of these regions. Nearly 2.7 Mha are reported to be affected in this manner. About 29 Mha shown as 'barren and unculturable land' constitute probably the most severely eroded areas. The magnitudes of 'culturable lands' and 'fallow land other than current fallows' indicate neglected land management. The areas categorised as 'permanent pastures' and 'other grazing lands' covering 13 Mha represent perhaps some of the worst eroded areas in the country.

5.4.5 Of 140 Mha of net area sown in the country with the excep-

tion of irrigated areas and areas under rice, about 87 Mha are exposed to soil erosion hazards. Up to the end of Fourth Plan only about 15 Mha of cultivated land had been treated with soil conservation measures. As more marginal lands are being brought under cultivation without adequate conservation measures, the erosion problem has been becoming increasingly acute. Besides, erosion is also caused by high velocity winds in arid and semiarid regions and along the seacoast.

5.4.6 It has been roughly estimated that about 150 Mha suffer from serious water and wind erosion, sedimentation damage and other types of deterioration in the country, and are in urgent need of scientific conservation and management. Out of this, an area 69 Mha is in a critical state of deterioration.

5.4.7 The urgency of soil conservation in catchment areas began to be felt towards the end of fifties when a higher rate of siltation, than expected, was noticed in certain reservoirs tending to reduce substantially their capacities. Soil conservation measures in catchments of river valley projects received priority since then. Even so, hardly 1.4 per cent of the catchment areas of major projects were treated for soil conservation up to 1973-74. It is generally considered enough to cover 10 to 15 per cent of the catchment area identified as crucial from the point of view of silt production, to tackle the problem effectively. Even on this basis, overall achievement had not been more than 10 per cent of the requirement. A rough estimate shows that the completion of the work would require five to six plan periods and would cost about Rs 1,500 crores. Since siltation of reservoirs is tending to overtake soil conservation in a number of projects, it is of importance to plan a firm strategy for completing the conservation work quickly, preferably within the next five years.

Past Efforts and Present Status

5.4.8 The degradation of land caused by ravines and mountain torrents or *chos* had drawn early attention of the Government and one of the first enactments for prevention of soil deterioration was passed in the Punjab in 1900 as Land Preservation Act.

5.4.9 Research on soil conservation was initiated in mid-thirties by the ICAR in typical dry farming areas. Till 1950 Maharashtra State did pioneering study on a big scale not only on problems of soil erosion and methods of conservation, but also on extension of conservation measures to cultivated lands. The assessment of benefits of soil conservation has revealed that (a) contour bunding resulted in augmentation of subsoil water supply in wells; and (b) contour bunding increased crop production up to 35 per cent, which was further

increased by 25 per cent by adopting dryfarming practices in bunded areas.

5.4.10 Greater attention was given to soil conservation works during the plans. One group of schemes undertaken related to contour bunding, terracing and other soil conservation measures. Another group related to watershed treatment for minimisation of siltation in reservoirs of major river valley projects and development of cultivated areas in the watersheds. A third group of schemes comprised construction of field embankments and pilot schemes in dryfarming on bunded or unbunded lands. Plantation of trees or cash crops on hill slopes and on banks of rivers and soil conservation in desert areas were the other important items of work taken up. Up to the beginning of the Fourth Plan about 9.4 Mha of cultivated areas were covered by soil conservation works and 0.2 Mha of culturable wastes were reclaimed for cultivation. Besides, surveys were undertaken to map ravine affected areas, of which some parts were reclaimed.

5.4.11 The Fourth Plan witnessed a definite change in the strategy of soil conservation work. While protection of watersheds of important river valley projects received continued emphasis, other schemes like soil and water management practices in irrigation commands, reclamation of ravine lands and development of dryfarming practices were included in the programme. It is now recognised that soil conservation is much more than erosion control and should provide for the conservation and all round development of both soil and water for sustained production at high level.

5.4.12 Replies to the questionnaire issued to the State show that very few States take up soil survey and land capability interpretation as a pre-requisite to soil and moisture conservation measures. Agro-climatic zones have been delineated on the basis of either rainfall or topography or soil but rarely on cropping pattern or land use. Bunding is the main item of soil conservation work. Land levelling and shaping work has mostly been done in the command areas of irrigation projects; very little work on land shaping has been taken up in dry areas.

5.4.13 Data relating to suspended sediment load in river systems are collected only at 432 sites from about 1,157 gauge and discharge sites, functioning at present. About 300 silt observation posts have been established under a Centrally sponsored scheme covering catchments of 21 river valley projects. The main object of these observation posts is to locate silt contributing areas requiring priority conservation treatment. However, compared to the dimension of the problem the available data are too meagre. Besides, there is considerable variation in the methods of data collection employed by different State

agencies. Estimates of siltation rates obtained from these data also need improvement. The work of gauging silt and discharge of various rivers and their tributaries should be a Central responsibility and adequate funds should be provided for the purpose.

5.4.14 Generally, storage projects which were completed decades back, have been adversely affected due to excessive siltation. In these circumstances particularly, soil characteristics, vegetative cover, land use changes, agroclimatic components including rainfall pattern etc, of the watersheds should be continually collected and systematically studied in order to take corrective measures. In respect of river valley projects the catchments of which are situated in more than one State, the data should be collected by the Ministry of Agriculture and Irrigation with the assistance of concerned States. The location of the gauging stations should be planned to cover all major situations. In view of the urgency and importance of sediment data, it should be made obligatory on the part of all discharge observation sites to obtain sediment data as well. At least 10 per cent of the observation units to be run by the Central agency should be 'A' class stations provided with sophisticated equipment and standard arrangements for observations and checks. By correlating the observations taken at such 'A' class stations with those of the remaining stations, the accuracy of information obtained in the latter should be improved as in 'B' or 'C' class stations. The available techniques of measuring suspended silt load and bedload rolling with river flow should be improved on the basis of research work.

Approach for the Future and Programmes

5.4.15 For the execution of long term programme of soil conservation and for sustained use of land for intensive production a soil and land use survey is essential. However, in many States soil conservation works have been executed without prior soil surveys and considerations of land capability. Some of the States have soil survey organisations but facilities in respect of equipment and trained personnel are meagre while others have no set-ups. The recommendations made in this regard in the Interim Report on Soil Survey and Soil Map of India are, therefore, reiterated.

5.4.16 The programme of soil surveys should include hydrological and erodibility groupings of recognised soils in order that soils producing sediments get quickly identified. Soils and land use survey should precede soil conservation measures so that the latter can be based on the recommendation of the former. Gaps noticed in the progress of either should be expeditiously bridged. In view of the

irreparable damage done to reservoirs by siltation, high priority should be attached to the treatment of those lands in the watershed which deliver the largest amount of sediment to reservoirs. Aerial photographs can spot places of severe erosion and identify channels carrying heavy silt load. Such aerial reconnaissance has been done for some catchment areas but supporting information like rate of erosion etc from different types of watersheds is lacking. A timebound programme needs to be drawn up for aerial survey of the remaining catchment areas and for correlation with sediment inflow and its transport via rivers and streams and delivery into reservoirs.

5.4.17 India is covered by a large net work of over 8000 raingauges. However, rainfall recording in most centres is unsatisfactory due to installation or exposure defects. Besides, data from nearly half the centres are not readily available. Only about 617 gauges, which include 500 departmental units, produce reliable data. To improve the situation the following measures are necessary :

- (i) Location of all raingauges should be ascertained, if necessary, by a special scheme within two years;
- (ii) all nonstandard raingauges should be replaced with standard ones;
- (iii) IMD's Plan for installation of 1,200 additional raingauges on the basis of WMO's recommendations should be re-examined;
- (iv) a special unit should be established in the IMD with powers and responsibilities and suitable financial assistance to instal additional network of raingauges and collect and publish all available data within a period of three years;
- (v) Correction factors applicable to all the defective raingauges should be determined as early as possible; and
- (vi) a minimum network of self-recording rain gauges as would enable publication of maps of short duration rainfall and frequencies within a period of 10 years should be established.

5.4.18 The problems of soil and moisture conservation are many; besides, there are limitations in the matter of execution like lack of trained personnel and finance. It will, therefore, be necessary to assign priorities to practices and areas that lend themselves to immediate high production and favourable benefit cost ratio. The areas may be divided into the following broad categories :

- (i) command areas of river valley projects;
- (ii) catchment areas of river valley projects;
- (iii) rainfed agricultural lands; and

(iv) other areas, such as pastures, forest lands, wastelands etc.

5.4.19 Soil and moisture conservation in command areas of river valley projects should undoubtedly receive the first priority. Life of a reservoir depends on the extent of silt being brought by runoff from catchment areas and deposited therein. Treatment of these areas by conservation measure would not only result in better benefits to the people inhabiting these areas but also help in prolonging the life of reservoirs. It is obvious that catchments should receive the same priority as command areas.

5.4.20 The problem of soil and moisture conservation is of particular importance in the medium and low rainfall areas. In most dry areas land is highly undulating as a result of erosion. Erosion creates differential topography of flats, slopes and valleys, each of which requires a specific conservation measure. Soil characteristics also play a dominant role in soil and moisture conservation as water infiltration and transmission are dependent on the physical properties of soil. Moisture conservation is more difficult in black soils whereas it is comparatively easy in other types, particularly red soils. Due consideration should, therefore, be given to physical and morphological characteristics of soils in the development of precise techniques for soil and moisture conservation.

5.4.21 In Maharashtra, where considerable work had been done on soil and moisture conservation in dry areas, a package of practices known as the 'Bombay Dry Farming System' was evolved and tried with good results. It helps to conserve soil moisture and ensure crop production. It is, however, of utmost importance that for realising maximum benefits, the package of practices for dry areas should be adaptable to different soils and agroclimatic regions.

5.4.22 Studies conducted in the dry regions of Maharashtra, where meteorological conditions are uncertain and erratic, have shown that out of the total rainfall, only 10 to 20 per cent is available to crops, the rest being lost as runoff, evaporation etc. There is a possibility of increasing the yield of crops provided water availability is augmented by adoption of suitable engineering and cultural methods. This can be achieved by taking recourse to water harvesting, a good instance of which can be found in the construction of farm ponds. The technique can be further improved and adopted in different regions with suitable modifications. Practices like nullah bunding, water spreading and renovation of old tanks should also receive urgent attention. In dry areas, for growing good crops and utilising moisture efficiently nutrients need to be supplied in adequate measure.

5.4.23 As an agronomic practice, alternating grass and crop varie-

ties is an important measure of soil and moisture conservation. Grass should find a place in multiple cropping programme. These are the basic practices on which introduction of short duration crops, foliar spray of nitrogenous fertilisers etc can be superimposed.

5.4.24 There are sizable areas of degenerated land in the catchments under private ownership, which would continue to be the foci of erosion unless steps are taken for conservation of soil and moisture. These lands can be taken up for development of farm forestry with the technical help of the Forest Department or else State Government should notify the owners of such lands for including them in land development schemes.

5.4.25 As natural reservoir sites are few, wherever a good site is located it is in the national interest to ensure that conservation work in the catchment is taken up simultaneously with the reservoir construction so that the life of the reservoir is prolonged. The problem may not be treated merely as one of saving the life of reservoir. Instead, it should be considered as part of programmes for maximising land use. To achieve this end, all related programmes should be drawn up in a coordinated manner.

5.4.26 Considering the limited forest area available in catchment areas of river valley projects, every bit of degraded forest land should be replanted and restored. According to the suitability of areas, a programme of either farm forestry or commercial forestry can be taken up to cover a substantial portion of these areas. Grass reserves should be created in forest areas and community lands. This would link up soil and moisture conservation of degraded areas in catchments with the programme of milk production and make both of them economical ventures.

5.4.27 Areas showing reasonable rise in productivity as a result of conservation measures should be identified in the catchment areas and an institutional programme of credit should be developed so that farmers may find it profitable to take up soil conservation work. This step would substantially minimise direct investment by State Governments for this work.

5.4.28 A review of large number of medium projects under construction showed how their hydrology concerned more than one State. By and large, it would be realistic to treat all storages with a hypothetical limit of 12.5 thousand hectare metres and above as having inter-State implications. The Centre should provide financial and supervisory assistance for watershed management in the case of such projects. Since the benefit accrues directly to the State in various ways, such projects should be financed by the Centre and States concerned.

5.4.29 Watershed management is a complex affair; as such it is

expedient to separate watersheds into a number of units or subwatersheds. The earlier practice of considering a big subcatchment of a few hundred square kilometres as the unit was hardly helpful in determining priority areas. Priorities should be decided on the actual or estimated sediment yields. It would be necessary to use the available data on hydrology and sedimentation and project the same into the ungauged areas with as much accuracy as possible.

5.4.30 The condition of the watershed and its management have a bearing on runoff volume, rate of discharge and rate of sediment load. A knowledge of all the three sets of data is necessary to plan should be initiated well in advance, preferably before the execution of the project itself. Advance action results in stabilisation of the watershed, thereby putting the water resources development project on a firm basis. The treatment strategy mainly consists in controlling sediment deposition followed by land treatment measures like bunding, terracing afforestation.

5.4.31 It is desirable that whenever water resources development is undertaken, watershed management is also initiated simultaneously. At present, the water resources projects are handled by one organisation whereas watershed management projects are handled by another. The two aspects are so intimately related that whenever a water resources development project is planned, the authority responsible for watershed management should simultaneously be associated with the former so that both the programmes run complementarily.

Organisation and Financing

5.4.32 For comprehensive planning and effective execution of soil conservation programmes, it is necessary to strengthen the organisation adequately to meet the requirements of a coordinated programme of conservation, use and management of soil and water. It would be necessary to have technically competent and numerically adequate number of personnel at all levels. It has to be recognised that soil and moisture conservation is a continuing programme and needs continuous follow up and maintenance. The jurisdiction of an Assistant Soil Conservation Officer should be fixed and he should be required not only to tackle fresh problem areas but also to maintain the areas already treated. Areas treated once may be taken up for fresh treatment after five to seven years depending on the state of deterioration.

5.4.33 The State soil conservation boards serve a limited purpose in matters of coordination, policy decision and execution. The boards do not appear to be the right type of organisation to launch a multidis-

ciplinary action programme like soil conservation. Instead, an inter-directorate committee presided over by the Agricultural Production Commissioner may take up soil conservation on a coordinated basis and as a special action programme. This would leave the boards with only policy making functions.

5.4.34 As for execution of works, it should be the responsibility of State Governments to execute soil conservation works initially at their cost. Adequate funds should, therefore, be provided in the annual budgets. The amount due from each land holder as cost of soil conservation work in cultivable lands should be recovered in suitable instalments depending on the nature of operation and cost involved. The number of instalments may be made conveniently larger in case of small and marginal farmers. In course of time this concession should be extended only to marginal farmers. As for lands suitable for afforestation and grass production, the Forest Department should suitably include them in their programme of afforestation and conservation and realise part of the expenditure from the sale of either forest produce or grasses.

Research and Training

5.4.35 One of the main functions of the Central Soil Conservation Board set up in 1953 was to organise, coordinate and initiate research in soil conservation. In pursuance of its objectives, the Board established nine regional research-cum-demonstration-cum-training centres to carry out research on regional problems, undertake fundamental research on hydrological laws governing the watershed behaviour, and to serve as demonstration centres. These centres are located at Bellary, Ootacamund, Dehra Dun, Agra, Hazaribagh, Vasad, Kota, Chandigarh and Ibrahimpatnam. Earlier, a research institute was started at Jodhpur in 1952 which developed into the Central Arid Zone Research Institute. The centre at Dehra Dun developed into the Soil and Water Conservation Research and Training Institute. These research centres have been concentrating on major regional problems of the country.

5.4.36 A critical review of work done at various soil conservation research centres shows that significant results have been achieved despite various constraints in staff and funds. These results, however, are mostly applicable to specific conditions. As local problems of soil conservation vary from State to State and within a State, from one area to another, the States are required to fill up the gap in these areas of research by playing an effective role. Some States have developed certain research facilities but these are meagre and far from adequate.

The developmental work that is generally carried out in various States is based on research information collected by the Central research institutions or on the experience of other States without regard to local soil and agroclimatic conditions. The Central soil conservation research centres do not represent all the problem areas in the country particularly the eastern region and the tribal areas practising shifting cultivation. The findings of these centres, therefore, needs to be tried on a wider scale to adapt them to different soil characteristics and environmental conditions in the country. It is also necessary to take suitable steps to study the special problems of the north eastern region and collect detailed information on the hydrological behaviour of different types of soils, their erodibility and proneness to yield sediment.

5.4.37 The urgent need for collecting reliable basic information about watersheds by setting up more stations of classes 'A', 'B' and 'C' spread over the entire country, has been emphasised earlier. Usefulness of the data so obtained for interpreting quantitatively the future behaviour of a reservoir is determined by the exactness of the functional relationship between the factors involved. Owing to lack of relevant research work in India, research workers have depended upon technical information from other countries which have different agroclimatic and other conditions. Experience, however, shows that in the case of watershed management the borrowing of such information may have serious consequences. It is essential, therefore, to have an indigenous research set up for investigating quantitative aspects of watershed management under conditions prevailing in the catchments of the river valley projects.

5.4.38 Studies on conservation hydrology already being conducted at various research centres need to be intensified so as to include watershed hydrology with special reference to precipitation, frequency distribution etc, rainfall erosion indices and infiltration rates and cumulative intake for different hydrological soil units.

5.4.39 Similarly, research work on conservation agronomy should be strengthened to include : (a) selection of crops, cropping systems, crop rotation, mixed cropping, intercropping and strip cropping with reference to rooting habits of crops; (b) tillage practices to optimise soil moisture regime in the root zone; (c) crop response at different stages of growth under various moisture levels; and (d) development of proper water harvesting and water recycling techniques for rainfed agriculture. The gap in available knowledge for improving extensive grazing lands, and maintaining grass reserves should also be filled up.

5.4.40 Priority should be given to studies aimed at evaluating the various factors in the Universal Soil Equation like erosion index, soil erodibility factors, crop management factor, degree and length of

slope factor and erosion control practices factor, particularly for the adopted crop rotations.

5.4.41 Studies on mechanical measures with reference to conservation structures, such as contour and graded terracing, bench terracing, grassed waterways and diversions should be augmented. Criteria for design of bunds, earthen dams and other soil conservation structures should be developed. Studies should be initiated on parallel terracing and zigzag terracing with a view to avoiding point rows and sharp turns for various agricultural operations using tractors. Deep black cotton soils should receive special attention in view of the lack of research on mechanical measures applicable to these soils.

5.4.42 There is also need to initiate studies of torrent control, land slides and ravine control especially in hilly regions with the ultimate objective of (a) classifying controlling and reclaiming gullies; and (b) evolving a package of practices to control roadside and railside erosion and techniques of stabilisation of problem areas, such as those frequently affected by landslides and torrents. Extensive studies on the problems of shifting cultivation and consequent hazards and steps to prevent them should be undertaken.

5.4.43 Agricultural universities should gradually build up expertise in the field of research and education in soil and moisture conservation. Suitable action should be taken to bring out manuals and handbooks incorporating research data and recommendations emanating therefrom for adoption in the field. The ICAR should be entrusted with the task of preparation and publication of such manuals for the benefit of State Governments. Afforestation being an important aspect of soil conservation, the collaboration of the Forest Research Institute may be sought in the preparation of the manual. The task of preparing field manuals necessary for the execution of soil conservation programme in the States should be entrusted to the respective State Governments. The regional centres, which are to help State Governments in planning and designing soil conservation measures, should periodically review these manuals and make them up-to-date.

5.4.44 No systematic work has so far been done to prepare an inventory of land resources and the problem areas in the country. A scientific appraisal of the land and soil resources should, therefore, be made by the Directorate of All India Soil and Land Use Survey to enable preparation of an inventory of the above resources, assess the nature and extent of soil and moisture conservation problems in the country, classify the country into different land resource regions and subregions and map them on a suitable scale.

5.4.45 In view of the large gap in the requirement and availability of trained personnel, the training facilities at various soil conservation

research and training centres should be strengthened. Training may be imparted to officers and graduate assistants at the Soil and Water Conservation Research and Training Institute and its substations. Inservice training to field assistants and subassistants may be imparted by the soil conservation organisations existing in the different States. This programme should receive a high priority.

5.4.46 Certain priorities should be assigned in the implementation of the recommendations regarding training and research in soil conservation. The following priorities are suggested :

- Priority I affording priorities facilities after ascertaining requirement of personnel from State Governments;
- Priority II strengthening research (both basic and applied) at the existing research stations to fill up the gaps in knowledge pointed out above;
- Priority III opening additional research stations; and
- Priority IV staring comprehensive pilot watershed studies.

5 ELECTRICITY IN RURAL DEVELOPMENT

5.5.1 Electricity plays an important role in agricultural production and development of rural economy. It can be used for lifting water, processing and preserving agricultural produce, organising small and medium scale cottage industries and providing amenities like lighting. It also helps the spread of education and dissemination of knowledge. It helps to modernise and the entire outlook of rural population. A number of studies made in recent years have shown that electricity makes significant contribution to the development of agriculture. Electric pumps are cheaper in capital and operational costs than diesel pumps. Speedy development of groundwater, therefore, requires that electric power should be available for the purpose, particularly in areas where there is paucity of surface water resources.

Development of Rural Electrification

5.5.2 In 1947, there were hardly 1300 villages which had been electrified and 6,400 pumpsets energised in this vast country, the power supply mostly by private undertakings being generally confined to a few urban and industrial centres. After Independence, the responsibility for power generation, transmission and distribution was taken over by the Government. Even then, progress was rather slow in the initial stages. It gained momentum only during the sixties when speedy development of groundwater for agricultural production received special attention. During the Fourth Plan more villages were elec-

trified and pumpsets energised than the total number up to the beginning of the Fourth Plan. At the end of the Fourth Plan period about 155,297 villages were electrified and 2.4 million pumpsets energised.

Programmes and Policies

5.5.3 The draft Fifth Plan envisages electrification of 110,000 villages and installation of about 1.5 million pumpsets. There would still be some 300 thousand villages to be electrified and 5.5 million wells to be energised. The tempo of rural electrification, therefore, needs to be stepped up so as to make electricity available to all the villages by 1990. Keeping in view the above targets, State electricity boards should prepare coordinated programmes of rural electrification in consultation with other development departments and take early action to implement the same.

5.5.4 Requirements of the agricultural sector should receive high priority in power distribution. It is also important that adequate and timely generation of power is ensured for meeting the needs of a large scale rural electrification programme. In the future programme of electrification, State Governments should take steps to encourage rural loads by permitting dispersal of industries to rural areas. Provision of electricity to *harijan basties*, fishermen's colonies and primary health centres should receive special consideration. Wherever famine relief funds are used for deepening existing wells or digging new wells, funds should also be provided for electrifying them.

Economics of Rural Electrification

5.5.5 Commercially, rural electrification is not attractive a proposition. The venture, therefore, was taken up in the public sector to be carried out by State electricity boards. The Electricity (Supply) Act, 1948 provides that the boards shall not, as far as practicable, carry on their operations at a loss and that they should give special attention in matters of power supply and distribution to areas which are either not served or inadequately served.

5.5.6 The most important use of electricity in rural areas is for energising lift pumps. The cost of energising would depend upon factors like proximity to distribution lines, existence of cluster of wells etc. For the energisation programme in the Fifth Plan, the cost of pumpset is assumed at Rs. 6,000. Taking the pumpset to be of 5 hp and a load factor of 15 per cent and allowing for 6 per cent interest on capital, 3 per cent towards operation and maintenance charges and 5 per cent for depreciation, the average cost per kwh would work out to 15 paise. To this is to be added the cost of generation of power

which ranges between 5 and 14 paise per unit, and that of transmission. On a reasonable tariff for agricultural use which cannot be pitched high as a matter of policy, there is invariably a loss to electricity boards in the initial years till the load builds up. In order to minimise the loss, it is important to bring about maximum economy in capital cost through standardisation without sacrificing safety considerations and to take steps to improve the load factor.

5.5.7 In the distribution of power, a certain amount of line loss is inevitable but this has to be kept to the minimum. Electricity boards should take urgent steps to bring down losses in existing systems occurring due to poor distribution layout, incorrect metering, theft of energy, etc and to ensure that future distribution systems are designed to give only tolerable line losses. The theft of power, unless put down firmly, can be widespread. For salutary effect, punishment for this offence has to be prompt and adequate. At present, State electricity boards do not enjoy adequate powers to enforce discipline in this regard. The Andhra Pradesh Electricity Board, however, has armed itself with powers to disconnect supply to any consumer caught committing such malpractices. Other State electricity boards too may adopt a similar approach. However, the power to disconnect should be exercised only by a responsible officer of the board.

Financing of Rural Electrification Schemes

5.5.8 On the recommendation of the All India Rural Credit Review Committee (1969), the Government of India set up the Rural Electrification Corporation (REC) to take care of rural electrification programme. It started functioning in 1970. The Corporation is suitably funded so as to enable it to provide long term loans at low interest to the State electricity boards for promoting schemes of rural electrification. The REC is required to pursue a project approach to various schemes, ensure appropriate standards of economic viability and also to make suitable relaxation in the criteria in the case of backward areas. More than half the number of projects approved by it till December, 1974 and appreciably more than half the amount it sanctioned, pertained to areas classified as backward, including those covered by the Minimum Needs Programme. The draft Fifth Plan provides nearly Rs 1,100 crores for rural electrification, of which about Rs 670 crores are to be channelled through the REC.

5.5.9 There are several areas in the country where no transmission or subtransmission lines are available to build up rural load, and without these lines no loads can be developed either. The REC gives special loans for laying such lines in approved areas if certain criteria

of expenditure are satisfied. It would be worthwhile to provide transmission lines in advance in backward areas for encouraging the use of electricity and facilitating quicker economic development of these areas. A part of the capital cost of the schemes, incurred by electricity boards in backward areas, may be subsidised so as to satisfy the norms prescribed by the REC. The REC may consider giving special loans for the 11 KV lines, if such lines facilitate electrification of isolated villages. Farmers should be given full credit facilities to meet the cost of electrification of their houses including initial cost and connection charges.

Difficulties of Rural Consumers

5.5.10 The rural consumer, especially the agricultural consumer, experiences several difficulties in the use of electricity. These mostly relate to getting the power connection, procuring equipment and ensuring their maintenance, interruptions and fluctuations in power supply and wrong billing.

5.5.11 In the matter of power supply, it is necessary that a system of priorities based on the date of application is strictly adhered to by electricity boards. It is desirable that the procedure for applying for electricity is published through leaflets in local languages. Electricity boards should also simplify the procedures laid down for giving power connection. The FSS or the *Panchayat* of the area should look into the complaints and grievances of the people in the matter of power supply and bring them to the notice of concerned authorities for redressal. When a farmer has secured a connection for his tubewell or pumpset, he should not be restrained from sharing with or selling water to other farmers.

5.5.12 A consumer is required to give a guarantee of minimum consumption. However, the inability to honour the commitment may arise out of circumstances beyond his control, like his wells going dry, prolonged interruptions or shut down in power supply, etc. In such cases the condition of minimum consumption guarantee should be waived.

5.5.13 Suppliers of farm equipment generally sell whatever is available with them without assessing the real needs of farmers. Agro-industries Corporations should be charged with the responsibility of supplying quality equipment at reasonable prices and of advising farmers on their use. Maintenance of motors and pumpsets is a major problem with farmers. The Ministry of Agriculture and Irrigation had formulated a proposal for setting up 5,000 agroservice centres with a view to providing various services and supplies to rural areas.

These centres should have licensed technicians for attending to such repair work. Burning of electric motors due to very low voltage is not infrequent in rural areas. The agroservice centres should help farmers in getting their motors rewound at reasonable rates. Also, the electricity boards should ensure that proper voltage conditions are maintained.

5.5.14 Defective meters and improper meter reading result in wrong billing and put the consumers to trouble. Pending investigation of a contested bill, the consumer may be charged on the basis of average consumption of past two months. Fictitious reading of meters should be considered a serious offence, and persons found responsible should be suitably punished. The system of sending bill collectors to specified villages on specified dates may be introduced with advantage. There is considerable pilferage of electrical equipment such as transformers, conductors, tubewell motors, etc which causes more hardship and loss to consumers than to Government. Electricity boards should elicit the cooperation of the public in checking these offences. Theft of conductors, transformers etc and the possession of such stolen articles should be made a cognizable offence under the Electricity Supply Act, as is the case under the Indian Telegraph Act.

5.5.15 As in all other developmental activities, public participation in rural electrification is important. Voluntary labour offered by the people in connection with the programme of rural electrification should be fully utilised and encouraged, which incidentally will also bring down the cost. The cooperative system of electricity distribution in rural areas should be encouraged.

APPENDIX 5-1

Cropped Area and Irrigated Area
(Paragraph 5·1·28)

(Million hectares)

State/Union Territory	Re-reporting area	Cropped Area and Irrigated Area										(Million hectares)						
		Intensity of cropping*			Gross area sown			Gross irrigated area			Percentage of gross irrigated area to gross area sown							
		1970-71	2000-2005	1970-71	1970-71	2000-2005	1970-71	1970-71	2000-2005	1970-71	1970-71	1970-2000	2005	2025	2025	2025	2025	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Andhra Pradesh	.	27.4	11.7	12.4	13.0	1.14	1.35	13.3	16.7	17.6	4.2	7.3	10.2	32	44	58		
Assam (incl. Mizoram)	.	7.8	2.2	2.3	2.4	1.24	1.50	1.60	2.8	3.5	3.8	0.6	1.5	2.5	21	43	66	
Bihar	.	17.3	8.5	10.0	11.0	1.31	1.40	1.45	11.1	14.0	16.0	2.7	9.0	13.1	24	64	82	
Gujarat	.	18.6	9.4	10.5	11.0	1.07	1.25	1.30	9.8	13.1	14.3	1.3	3.9	5.0	13	30	34	
Haryana	.	4.4	3.6	3.5	3.4	1.39	1.50	1.50	4.9	5.3	5.1	2.2	3.3	3.3	45	62	64	
Himachal Pradesh.	.	5.1	0.5	0.6	0.7	1.67	1.70	1.70	0.9	1.0	1.2	0.2	0.2	0.2	17	20	17	
Jammu & Kashmir	.	4.5	0.7	0.8	0.8	1.23	1.30	0.9	1.0	1.0	0.3	0.6	0.7	33	60	6		
Karnataka	.	18.9	10.2	11.2	11.5	1.06	1.25	1.25	10.9	14.0	14.4	1.4	4.3	5.9	13	31	41	
Kerala	.	3.9	2.2	2.2	2.1	1.35	1.45	1.50	2.9	3.2	3.2	0.6	1.6	2.6	21	50	8	
Madhya Pradesh	.	44.2	18.4	20.2	21.0	1.13	1.30	1.35	20.6	26.3	28.4	1.5	5.9	9.1	7	22	32	
Maharashtra	.	30.8	17.7	19.0	19.7	1.06	1.25	1.25	18.8	23.8	26.4	1.7	5.3	6.5	9	22	26	
Manipur	.	2.2	0.1	0.3	1.05	1.20	1.40	0.1	0.3	0.4	0.1	0.2	0.2	40	50	60		
Meghalaya	.	2.2	0.2	0.3	1.20	1.40	1.50	0.2	0.3	0.4	..	0.1	0.1	20	25	25		
Nagaland	.	1.4	0.1	0.2	1.00	1.20	1.40	0.1	0.2	0.3	..	0.1	0.2	12	35	45		
Orissa	.	15.5	6.1	6.8	7.0	1.11	1.50	1.50	6.8	10.2	0.5	1.6	4.3	6.7	24	42	64	

APPENDIX 5·1 (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Punjab	.	.	5·0	4·1	4·0	3·9	1·40	1·50	1·50	5·7	6·0	5·9	4·2	5·0	5·0	75	83
Rajasthan	.	.	34·1	15·2	14·0	14·0	1·10	1·10	1·10	16·7	15·4	15·4	2·5	4·4	4·8	15	29
Tamil Nadu	.	.	13·0	6·2	6·8	7·0	1·20	1·35	1·35	7·4	9·2	9·5	3·4	4·0	4·0	46	43
Tripura	.	.	1·1	0·2	0·2	0·2	1·44	1·45	1·50	0·3	0·3	0·3	..	0·1	0·1	7	25
Uttar Pradesh	.	.	29·8	17·3	18·6	19·0	1·32	1·45	1·50	23·2	27·0	28·5	8·4	18·1	24·0	36	67
West Bengal	.	.	8·9	5·6	5·8	6·0	1·28	1·40	1·50	7·2	8·1	9·0	1·5	4·4	5·5	21	54
Union Territories	.	.	9·2	0·4	0·4	0·5	1·30	1·30	1·40	0·5	0·5	0·7	0·1	0·2	0·3	24	40
All India	.	.	305·3	140·4	150·0	155·0	1·18	1·33	1·36	165·1	199·4	210·0	38·5	84·0	110·0	23	42
																or 200·0	

*The projected intensity of cropping has been arrived at by considering (a) rainfall, (2) irrigation potential, and (3) the need of equitable distribution of irrigation resources.

APPENDIX 5·2

(Paragraph 5·1·28)

Irrigated Area

(million hectares)

States	Net area irrigated	Intensity of cropping in irrigated area*	Gross area irrigated				Irrigated from surface water				Irrigated from ground water				
			1970-71	2000-01	1970-71	2000-01	1970-71	2000-01	1970-71	2000-01	1970-71	2000-01	1970-71	2000-01	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Andhra Pradesh	3.3	5·4	7·3	1·23	1·35	1·40	4·2	7·3	10·2	3·5	5·6	8·0	0·7	1·7	2·2
Assam (incl. Mizoram)	80·6	1·0	1·6	1·00	1·50	1·60	0·6	1·5	2·5	0·6	1·0	1·8	..	0·5	0·7
Bihar	2·2	6·1	8·7	1·26	1·45	1·50	2·7	9·0	13·1	2·0	6·0	9·0	0·7	3·0	4·1
Gujarat	1·2	3·1	3·8	1·08	1·25	1·30	1·3	3·9	5·0	0·3	2·6	3·5	1·0	1·3	1·5
Haryana	1·5	2·2	2·2	1·46	1·50	1·50	2·2	3·3	3·3	1·4	2·0	2·0	1·0	1·3	1·3
Himachal Pradesh	0·1	0·1	0·1	1·56	1·70	1·70	0·2	0·2	0·2	0·2	0·2	0·2	0·2	@	@
Jammu & Kashmir	0·3	0·5	0·5	1·20	1·30	1·30	0·3	0·6	0·7	0·3	0·5	0·5	0·5	0·1	0·2
Karnataka	1·1	3·4	4·5	1·19	1·25	1·30	1·4	4·3	5·9	1·1	3·0	4·3	0·3	1·3	1·6
Kerala	0·4	1·1	1·7	1·40	1·45	1·50	0·6	1·6	2·6	0·6	1·4	2·3	QE	0·2	0·3
Madhya Pradesh	1·5	4·5	6·7	1·03	1·30	1·35	1·5	5·9	9·1	0·9	3·6	6·1	0·6	2·3	3·0
Maharashtra	1·4	4·2	5·0	1·16	1·25	1·30	1·6	5·3	6·5	0·8	3·7	4·7	1·8	1·6	1·8
Manipur	0·1	0·2	0·2	1·15	1·20	1·40	0·1	0·2	0·2	0·1	0·1	0·2	@	@	@
Meghalaya	..	..	0·1	0·1	1·00	1·40	1·50	..	0·1	0·1	..	0·1	0·1	@	@
Nagaland	..	..	0·1	0·2	1·00	1·20	1·40	..	0·1	0·2	..	0·1	0·2	@	@
Orissa	1·2	3·0	4·5	1·42	1·50	1·50	1·6	4·5	6·7	1·5	3·3	5·2	0·1	1·2	1·5
Punjab	2·9	3·3	3·3	1·46	1·50	1·50	4·3	5·0	5·0	2·0	2·2	2·2	2·3	2·8	2·8

APPENDIX 5.2 (Contd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Rajasthan	.	.	.	2.1	3.8	4.2	1.15	1.15	2.5	4.4	4.8	1.1	2.7	2.9	1.4	1.7	1.0	
Tamil Nadu	.	.	.	2.6	3.0	3.0	1.31	1.35	3.4	4.0	4.0	2.4	2.5	2.5	1.0	1.5	1.5	
Tripura	0.1	0.1	1.00	1.45	1.50	..	0.1	0.1	..	0.1	0.1	@	@	
Uttar Pradesh	7.2	12.5	16.0	1.16	1.45	1.50	8.4	18.1	24.0	3.6	7.6	11.0	4.8	10.5
West Bengal	.	.	.	1.5	3.1	3.7	1.03	1.40	1.50	1.5	4.4	5.5	1.5	2.4	3.0	@	2.0	
Union Territories	.	.	.	0.1	0.2	0.2	1.25	1.30	1.40	0.1	0.2	0.3	0.1	0.2	0.2	@	0.1	
All India	.	.	.	31.3	61.0	77.6	1.23	1.38	1.42	38.5	84.0	110.0	24.0	51.0	70.0	14.5	33.0	40.0

② Negligible (less than 50,000 hectares)

* The projected intensity of cropping has been arrived at by considering (1) rainfall (2) irrigation potential, and (3) the need of equitable distribution of irrigation resources.

CROP PRODUCTION, SERICULTURE AND APICULTURE

6.0.0 Various aspects of production and development of as many as 70 individual crops have been considered by the Commission. As the development of sericulture and apiculture depends on the raising of host plants, which have problems common with other crops, their growth problems have also been studied together. For the crops studied, estimates of area and yield potential for 2000 AD have been indicated (*vide* Appendix 6.1) along with the measures necessary for achieving their levels. A broad idea has also been given of the areas of research and development which will need special attention.

6.0.1 The genetic potential of the existing varieties of different crops is 3 to 4 times the present average yields. Taking into account the yield levels attained in Government experimental farms and the national demonstration plots, it is estimated that by 2000 AD the yield levels would be 2 to 3 times the existing levels. The targeted yields and production levels of different crops for 2000 AD are based on the assumption that the cultivation of various crops would, by that time, be confined to the most appropriate zones and have the required backing of inputs like irrigation, quality seeds, fertilisers, plant protection chemicals, etc. and use of appropriate implements and tools. Since all these factors are crucial to the attainment of the contemplated yield and production levels, any deviation from the cropping pattern or the levels of inputs and extension envisaged would result in the lowering of the targeted levels.

1 REORIENTATION OF CROPPING SYSTEM

6.1.1 Farming systems can be basically classified into : (a) rainfed farming and (b) irrigated farming, with mixed farming being a characteristic common to both. Given the farming system relevant to an agroclimatic region, the objective should be to impart a progressive orientation to farming in that region by readjusting its cropping pattern to suit its rainfall rhythm if it is rainfed, and its water availability, if it is irrigated. In doing so, an integrated view will have to be taken of the cropping pattern in relation to rainfall

and irrigation involving various other related factors such as the need for short duration crops, soil and moisture conservation, supplemental irrigation, multiple cropping etc. so as to adopt a farming system most appropriate to the conditions of that region.

Rainfed Farming

6.1.2 In areas where farming depends exclusively on rainfall, the farming system is determined to a great extent by the amount and duration of rainfall, which varies from place to place and from year to year, the variation being as much as hundred per cent in some places. According to total rainfall, the areas can be identified into four groups, viz., heavy rainfall areas, high medium rainfall areas, low medium rainfall areas and low rainfall areas.

6.1.3 The heavy rainfall areas receive rainfall of 30 cm per month for at least three out of four monsoon months, from June to September. In some areas, similar rainfall may occur for six months covering the pre-monsoon as well as the post-monsoon periods. In some other areas, rainfall of a lesser magnitude may occur beginning from March and extending upto November. Paddy is the dominant crop all over these areas. There is considerable scope for diversifying cropping by introducing crops before and after paddy especially in areas where the rainy season extends for a longer period. Pulses, vegetables, fodder and green manure crops can be grown in areas where rainfall covers pre and post-monsoon periods. In the hills, field crops can be restricted to the valleys and the hilly slopes covered by plantation or forestry or grasses which could help maintain soil fertility and prevent soil erosion.

6.1.4 In the heavy rainfall areas, the problem of holding soil *in situ* and maintaining soil fertility is in fact acute. There is, therefore, need for an appropriate research organisation not only to study the problems relating to soil conservation and maintenance of soil fertility in these areas, but also to evolve diversified cropping systems under which areas could be marked out for man-made forests, plantation and fruit crops and grazing lands. In these areas attention should be given to storing water in deep valleys towards the end of the rainy season for using it for growing crops during the post monsoon period, thereby lengthening the cropping season and helping crop diversification. There is also scope for sinking shallow wells in paddy fields to tap groundwater during prolonged spells of drought. Such wells may be dug in every paddy fields in heavy rainfall areas to ward off the danger of water scarcity. As seeds deteriorate fast in these areas, the seed material has to be produced outside and

brought to these areas for cultivation. Likewise, since animals deteriorate because of the poor quality of fodder, which is low in nutrition, suitable mechanical equipment will have to be developed as an alternative source of power for cultivation of crops. Intensive studies are necessary both with regard to production and supply of seeds as well as nutritious fodder for animals.

6.1.5 The high rainfall areas are prone to frequent floods. The farming strategy in such areas, particularly of Assam and Bihar, should be such as to avoid cultivation during the flood prone months of July and August and alternatively to think of crops which can grow under deep water conditions. The kharif crops of rice and jute must either be sown early or be of such varieties as would endure flooding (eg deep water rice.)

6.1.6 In low rainfall areas (250 to 750 mm per year), found in high as well as low latitudes, the rainfall is highly variable with regard to both quantity and distribution. This has made agriculture highly unstable throughout the low rainfall region. A variety of crops is grown in these areas without any one crop dominating the cropping pattern. Jowar, bajra, ragi, groundnut and grams are among the important cereals. All kinds of millets, oil seeds and pulses are also grown in these areas where mixed cropping is very common. It is possible to change the cropping system by introducing new crops such as forage crops, especially forage legumes, in rotation with field crops so that the increased use of forage crops can provide the base for a viable animal husbandry programme in these areas which abound in very good breeds of cattle and sheep. Forage crops would also help in building up the organic matter content of the soil. Mixed and relay cropping are possible not only with forage crops but also with crops such as short duration varieties of kharif jowar, barley, safflower, etc. Such possibilities of changing the crops and the cropping pattern are greater in southern parts where the rainy season is spread over a longer period.

6.1.7 Any lasting improvement in cropping system in the low rainfall areas is, however, possible only through improved soil and water conservation measures supported by appropriate programmes of land consolidation and intensified contour bunding schemes. So far, it is the failure to deal with aberrant weather that has led to fluctuating levels of agricultural production in dry areas. Any action to minimise such fluctuations would need plans for : (a) monitoring weather to help early identification of the aberrant season; (b) implementing alternative cropping strategies including the strategy of raising fodder crops when the season is no longer conducive to the growing of field crops; and (c) capitalising on the normal and above

normal rainfall periods. Realising the importance of detailed crop planning in drought affected areas, the Indian Council of Agricultural Research (ICAR) has got typical crop production plans prepared for Anantapur and Ahmednagar districts under the All India Coordinated Dryland Research Project indicating factors limiting crop production in these areas and suggesting appropriate cropping strategies to tackle them. Similar analysis and contingent crop plans should be developed for all the 72 drought prone districts in the country so that they could be implemented as farmers' programmes for drought proofing the areas concerned. Meanwhile, as part of certain basic practices essential for agricultural planning in drought prone areas, measures should be undertaken to ensure better moisture regime and to harvest, store and recycle runoff water for crop production. Mulching, creation of shelter belts of trees and weed control reduce loss of all stored soil moisture. Contour bunding, vertical mulching and deep ploughing enhance water absorption into the soil profile. In view of the available technology, these practices constitute an essential package for the implementation of cropping programmes in the drought prone areas.

6.1.8 The medium rainfall areas (75-150 cm) are broadly divided into high medium rainfall and low medium rainfall areas where paddy dominates. In these areas, there is considerable scope to adjust cropping to the rainfall distribution and develop mixed cropping and relay cropping practices to grow crops such as maize, cotton, soyabean etc. which require less water than paddy. Similarly, with better management of soil and water resources and supplemental irrigation through tanks and wells, these areas can grow fruit and vegetable crops, and also support a good animal husbandry programme. In slopy areas, which are susceptible to soil erosion, the emphasis should be on the development of forests, fruit cultivation and dairy farming with the support of necessary infrastructural facilities for processing, storage, and marketing. In the belt adjoining the low rainfall areas (*i.e.* the low medium rainfall areas), rainfall is sufficient to raise a number of arable crops such as jowar, maize, cotton, sunflower, soyabean and other pulses. With the support of irrigation through tanks and wells, fruit and vegetable crops can be introduced. Paddy should be discontinued and leguminous fodder crops grown to support dairy farming. The main objective should be to fit crops into the climatic rhythm of these areas.

Irrigated Farming

6.1.9 Irrigated farming could help to extend the cropping season and make intensive agriculture possible. Depending upon the source

of water supply, *viz.*, major or medium irrigation projects or minor irrigation works like tanks, tubewells and open wells, irrigation could be available either for the whole year or for eight months in a year, facilitating the growing of either perennial crops like sugarcane, plantation and fruit crops and long season crops like cotton. The main aim in irrigated farming should, however, be to increase the water use efficiency in order to optimise the yields per unit of water.

6.1.10 In developing an appropriate farming system in the irrigated areas, certain fundamental issues need consideration. They are : (a) the advisability of encouraging summer irrigation for crops such as paddy instead of other value crops which give better returns and (b) the desirability of intensive as against extensive irrigation. Where water is available throughout the year, it should be possible to raise crops in all seasons including the summer season. In areas where water has to be stored for a prolonged period for being made available for summer irrigation and thereby become subject to evaporation losses, it has to be considered whether it is advantageous to do so. Currently, the tendency is to grow paddy during the summer months because of the possibility of getting very high yields. The merit of such a cropping system will have to be necessarily left to the decision of the individual farmer.

6.1.11 As regards the intensive and extensive systems of irrigation, the extensive irrigation system is being adopted for its obvious social benefits. Its advantage could be maximised if cropping is based on the conjunctive use of rainfall, surface water and ground-water which helps in the economical use of water during the different cropping seasons. If, in the irrigated areas, rainfed cropping is encouraged so as to promote maximum use of rainfall without depending on irrigation, which should be made available only when necessary, intensity of cropping will greatly increase. There is thus considerable scope for improving the cropping systems in irrigated areas by adopting advantageous crop rotations through mixed cropping, relay cropping and intercropping. Cultivation of pulses and leguminous forage crops in rotation with field crops or as intercrops should be introduced in canal irrigated tracts which helps not only green manuring but also maintenance of soil fertility. Intensive cropping under irrigated conditions gives rise to weeds as well as pests and diseases. Special weed control measures and pests and disease management practices should, therefore, be developed for these as well as the heavy rainfall areas.

6.1.12 In addition to irrigated farming, riverbed cultivation, which has so far not received the attention of scientists and extension

workers, should be developed as a distinct type of cultivation specially for vegetables and melons. Similarly, utilisation of sewage water for farming using town effluents for irrigation should also be developed with necessary financial assistance to the Municipalities and by recovering a part of the expenditure by levy on the organisation concerned.

Cropping Systems

6.1.13 Considerable research material is available on various systems of multiple cropping (*eg* intercropping, strip cropping, companion cropping, relay cropping, etc.), which indicates immense possibilities of affecting changes in the existing cropping systems in the irrigated and unirrigated areas of different regions in the country. It is necessary to reappraise the various possibilities in this regard so that cropping patterns as are appropriate to every taluk could be evolved taking into consideration the variation in soil types, rainfall conditions and intensity of irrigation. The cropping systems so evolved should be put into operation through active extension efforts with a machinery to assess the impact and to effect mid-course alterations, when necessary.

2 FOODGRAIN CROPS

6.2.1 The crops included are : rabi cereals (wheat, barley, oat, rye and triticale), and kharif cereals (rice, maize, jowar, bajra, ragi and other small millets) and various kinds of pulses. There is no scope for further increase in the total area under these crops, which is at present as high as 75 per cent of the gross cropped area. The increasing demand for other crops makes it imperative to plan for a rational redistribution of cropwise area and for improving yield levels and also minimising fluctuations in production levels caused by the vicissitudes of weather.

Rabi Cereals

6.2.2 The region comprising Punjab, Haryana, Delhi, Uttar Pradesh and Madhya Pradesh account for the bulk of area (70 per cent) as well as production (74 per cent) of wheat in the country. Rajasthan and Gujarat in the west and Bihar and West Bengal in the east come next accounting for about 20 to 22 per cent of both area and production. Yields vary from 1 to 2.3 tonnes per ha

excepting in Madhya Pradesh which records 0.78 tonnes/ha. In Maharashtra and Karnataka, yields are around 0.5 tonnes/ha.

6.2.3 Wheat yields are determined by the extent of irrigation support available since neither the monsoon nor the winter rainfall by itself is sufficient for optimising production. With high yielding varieties and needed inputs, yields of 4 to 4.5 tonnes/ha are possible in irrigated areas. Being a low temperature crop, wheat yields are very low in the peninsular regions of Maharashtra and Karnataka, which can be increased provided early maturing high yielding varieties are developed for the shorter and milder winter conditions prevailing in these States. Besides, yields from unirrigated wheat can also be raised to about 2 tonnes/ha provided high yielding varieties are evolved and appropriate growing techniques developed.

6.2.4 It is estimated that the wheat area under irrigation will go up from about 9.5 Mha at present to about 15 Mha in 2000 AD. The yield of irrigated wheat is expected to increase to 3 to 4 tonnes/ha and that of un-irrigated wheat to 1.5 to 2 tonnes/ha, the all India average being 3.64 tonnes/ha. Keeping this in view, a marginal reduction of 0.46 Mha in the present wheat area of 18.01 Mha is suggested.

6.2.5 To achieve the projected yield levels, it is necessary to diversify wheat varieties for resistance to major diseases instead of depending on the very few varieties with narrow genetic base being cultivated at present (eg Kalyanasona and Sonalika). The hills in the north as well as in the south are the primary foci of infection for brown, yellow and black rusts. Either wheat cultivation should be eliminated from such areas altogether or wheat varieties resistant to rust should be developed and introduced. As all varieties may develop susceptibility with the passage of time, a surveillance service for rust detection on cultivated wheat fields will have to be organised. Storage losses should be minimised through control of storage pests. Whereas the existing tempo has to be maintained in all round research, a special programme of evolving varieties and agricultural techniques suited to winter conditions of the peninsula should be put into operation. Due attention should be paid to research work to durum and dicoccum species which hold promise for the south. Special varieties of wheat are required to be bred and cultivated for milling, baking and confectionery industries.

6.2.6 Barley gives reasonable yields even under low fertility conditions. Uttar Pradesh accounts for the major area and production (53 per cent) with Rajasthan, Punjab, Haryana, Bihar and Madhya Pradesh being the other States engaged in barley cultivation. The area under barley can be raised from 2.58 Mha to 5.5 Mha

including 0.34 Mha of saline and alkaline lands. An area of 1.30 Mha can be earmarked for irrigated barley. Large areas under rabi fallows in Uttar Pradesh, Bihar, Punjab and Haryana can be brought under barley and 0.46 Mha of wheat area can be transferred under this crop. Irrigated barley can give a modest yield of 3.5 tonnes/ha and unirrigated barley about 1.5 tonnes/ha by 2000 AD.

6.2.7 The present barley varieties are tall and prone to lodge even under ordinary fertilisation. Research attention is being given to evolving semidwarf fertiliser responsive varieties but these need irrigation. The pest and disease problems also need attention. Research to develop agronomic schedules for unirrigated conditions including breeding and plant protection programmes for improved yield and nutritional quality will have to be intensified. Varieties and techniques suitable to saline and alkaline lands have also to be developed. Among other aspects, attention should be given to developing lodge-resistant varieties, breeding suitable varieties for high quality malt, improving lysine and total lipid content and breeding hull-less varieties to improve digestibility.

6.2.8 Oat is both a food crop and a feed crop. It is a good rabi fodder crop amenable to late sowing and a source of green fodder even up to April and May in Punjab and adjoining parts. It has a great potential in future programmes of dairy development as a major source of proteinous green fodder together with lucerne and berseen. Being a high water requiring crop, not much area can be put under oat grain. It is only in recent years that scientific work on breeding of improved varieties has been taken on hand. Not much work has been done on agronomic and plant protection practices. Breeding for nonlodging short straw varieties responding to high fertiliser doses and improvement in grain quality need attention. Rye crop is not of any economic significance in India and its cultivation is not expected to be significant even in future. Triticale is still in an experimental stage and requires further research. It need not be considered for future planning.

Rice

6.2.9 Rice is the main cereal of the country accounting for 80 per cent of area and 40 per cent of production of all cereals and pulses put together. Rainfall conditions over most part of the country are not ideally suited for rice cultivation. The rainy period being confined to only four south west monsoon months in Uttar Pradesh, most of Bihar, Madhya Pradesh, Gujarat, Maharashtra, parts of Andhra Pradesh and Orissa, rainfall cannot be depended

upon in these States for rice cultivation in other months. On the other hand, the States of Assam, West Bengal, coastal Orissa, coastal Andhra Pradesh and southern States of Karnataka, Tamil Nadu and Kerala receive rainfall of 10-20 cm per month for four to eight consecutive months covering the pre as well as the post-monsoon period. Only one rice crop is taken in the former group of States and 2 to 3 crops in the latter. The main problem in the monoseason belt (Uttar Pradesh, Madhya Pradesh and Bihar) is that July and August are the only two months of adequate rainfall for the rice crop with the attendant problem of excessive rainfall and floods. The region also needs supplemental irrigation during breaks in July and August and in September. If the excessive rainfall could be stored and used for irrigation, the rice crop can perform better.

6.2.10 In the north eastern States and West Bengal and Orissa three crops are raised—a pre-monsoon (Feb-May) crop, the monsoon crop and a post-monsoon (Oct-Jan) crop. The monsoon crop is the main crop which is affected by floods. In Orissa, rainfall is limited to July and August needing supplemental irrigation during the season. The pre-monsoon (Feb-May) crop should be given up in this State and efforts concentrated on improving yields of the monsoon crop by utilising the water saved on the summer sown crop for raising nurseries and early transplantation of the monsoon crop. In the north eastern States and West Bengal and Orissa, which receive some rainfall up to October, farmers are doing well in the post-monsoon (Oct-Jan) crop, helped by a growing season which is free from floods and has other conditions congenial for a good crop. All possible efforts should, therefore, be made to increase the area under this crop with irrigation support by harnessing the surplus rain water of the monsoon period.

6.2.11 Recent advances in rice crop improvement resulting in the release of high yielding varieties and propagation of improved package of practices have led to substantial increases in grain yields—6 tonnes/ha in demonstration plots in West Bengal and 7 to 15 tonnes/ha at the All India Coordinated Rice Improvement Project centres. Under field conditions, the maximum yield obtained is about 2 tonnes/ha, the all India average being only 1.11 tonnes/ha (in terms of rice). The yields are above the national average in Punjab, Haryana and in the southern States but are only 70 per cent of all India average in Uttar Pradesh, Bihar and Madhya Pradesh. Rice is grown under conditions which vary from place to place and one coordinated system of research cannot be sufficient to answer the needs of such situation. A regional system of coordination should be attempted for the rice crop, each region independent and self-

sufficient by itself in research and extension efforts and having its own research institute of all India status. Problems of all India nature could be looked after by the Central Rice Research Institute in collaboration with these institutes. For this purpose, the regions could be : (a) Jammu & Kashmir, Himachal Pradesh and West Uttar Pradesh Hills; (b) Punjab, Haryana, Delhi and Rajasthan; (c) Gujarat and Maharashtra (excluding coast); (d) Uttar Pradesh (plains), Madhya Pradesh and Bihar; (e) West Bengal and Orissa; (f) North Eastern States; (g) Karnataka (excluding coast), Andhra Pradesh and Tamil Nadu; and (h) Kerala, coastal Karnataka and Maharashtra.

6.2.12 Some of the important problems of paddy cultivation which need attention are mentioned below :

- (i) Early maturing high-yielding varieties with some degree of tolerance and resistance to blast need to be evolved for the hilly areas.
- (ii) The west coast from Kerala to Gujarat, which receives heavy rainfall, needs late and medium duration high yielding varieties. The steep slopes of the Western Ghats towards the seaside give rise to problems of water and soil management. Appropriate measures to harness water will prevent soil erosion and give a new orientation to paddy cultivation in the Ghats. Attention is also required to improve the leached out soils by adopting suitable agronomic and water management practices.
- (iii) The north eastern States and sub-Himalayan West Bengal including the areas of Bihar and Gangetic West Bengal, are subject to deep water conditions due to frequent flooding. High yielding rice varieties, which can successfully grow under deep water conditions, have to be evolved. Similarly, the possibility of cultivation during flood free periods in parts of Bihar and in Brahmaputra valley should be explored. In the suddenly changing topography of the north eastern hills, varieties of different duration are needed; early maturing varieties for the uplands, late maturing varieties for the low lands and varieties of intermediate duration for other areas.
- (iv) Nonlodging varieties with higher tillering characteristics are required for areas in Bihar, Orissa, Uttar Pradesh, Madhya Pradesh and West Bengal which have serious water lodging problems.
- (v) The nonconsumer areas like Punjab, Haryana, Rajasthan, Uttar Pradesh hills and adjoining parts should be en-

couraged to grow high quality rice for export.

6.2.13 The main research problem which call for special attention in the case of rice are : (a) to fit the varieties as well as agronomic practices to local rainfall rhythm of different parts; (b) water and soil management under excess as well as deficient rainfall conditions; and (c) finding suitable varieties for different situations (hills, valleys and plains etc) and for different crop seasons.

6.2.14 With adequate research and extension support, it should be possible to increase rice yields to 3.5 tonnes/ha in the States of Punjab, Haryana, Karnataka and Tamil Nadu, 3.2 tonnes/ha in Kerala, Andhra Pradesh and West Bengal, 3 tonnes/ha in north eastern States, Orissa, Rajasthan, Gujarat and Maharashtra and 2.8 tonnes/ha in Uttar Pradesh, Bihar, Madhya Pradesh and 3 tonnes/ha in other areas by 2000 AD. Based on these projected yield levels, 3.27 Mha of paddy areas in Uttar Pradesh, Madhya Pradesh and Bihar, 0.99 Mha in West Bengal and 1.0 Mha in Andhra Pradesh, Tamil Nadu and Karnataka may be reduced and diverted to crops such as cotton, groundnut and maize in the south and maize, soyabean and black gram in the other States. In doing so, rice should be withdrawn from uplands where no supplemental irrigation is possible. Where tank irrigation is practised, as in the south, rice should be confined to areas fully covered by irrigation, avoiding lift irrigation as far as possible.

6.2.15 The above measures will reduce the area under rice by 15 per cent to 32 Mha and enable to provide supplemental irrigation for 75 per cent of the total area and increase rice production to 97 million tonnes with an all India average yield of 3.04 tonnes/ha in 2000 AD.

Kharif Cereals other than Rice

6.2.16 Maize, jowar, bajra, ragi and other small millets account for 40 per cent of the area under kharif crops and are distributed in different rainfall categories. Given the rainfall distribution, the choice of kharif crops is generally found to be rice, maize, jowar, bajra, ragi and other small millets in the same order, from rice in the most productive land to ragi and small millets in the least productive. In this way, the largest areas under maize is in the good rainfall regions denoting its high water requirement. Jowar and bajra, on the other hand, are found to be distributed over a wide spectrum of rainfall distribution. Ragi and millets are preferred in areas receiving low amounts of rainfall.

6.2.17 Maize is confined to the belt comprising eastern Uttar

Pradesh, Bihar, Madhya Pradesh and adjoining parts accounting for 65 per cent of area under the crop. Yields are, however, the lowest in this region at 0.8 tonnes/ha. The crop is susceptible to water logging in the雨iest months of July and August and also subject to moisture stress around the reproduction phase because of breaks in monsoon in August and September. The drainage problem in maize in these areas calls for appropriate cultural methods. Gujarat with most area under A1 type of rainfall gets a yield of 1.4 tonnes/ha with better rain management. Himachal Pradesh, Punjab, Haryana and Jammu & Kashmir get yields varying from 1.4 to 1.6 tonnes/ha because of advantage of natural drainage provided by slopes and irrigation support (Punjab and Haryana).

6.2.18 Keeping in view the demand for maize in industry and for piggery and poultry, it is necessary to rationalise the area under maize in a manner so as to restrict its cultivation only to A₂—B₂ category of rainfall minimising the need for irrigation. An additional area of 4.7 Mha will have to be brought under maize mainly in the surplus rice areas of Uttar Pradesh, Madhya Pradesh, Bihar and West Bengal (3.8 Mha), and Andhra Pradesh, Karnataka and Tamil Nadu (0.9 Mha). The rabi crop of maize should be encouraged in Orissa, Andhra Pradesh, Karnataka and Tamil Nadu.

6.2.19 Some of the essential measures which can help increase maize production are : introduction of early varieties in place of existing high yielding maize hybrids, which are comparatively late maturing; (b) establishment of optimum population stand through the development of high population responsive maize variety; and (c) identification of better sources of resistance to pests and upgrading level of resistance in selected population. With these measures it should be possible to raise the yield level to 2.65 tonnes/ha.

6.2.20 Given the rainfall type, the choice of jowar area is determined by soil characteristics which vary widely. Since jowar and bajra compete for the same type of land, there is need to increase and stabilise the jowar area from 8.5 Mha at present to around 17 Mha in 2000 AD. With a projected yield level of 1.20 tonnes/ha, the production of jowar will be 20.4 million tonnes in 2000 AD.

6.2.21 There is vast scope for improving jowar yields, which are very low at an average of 0.48 tonnes/ha. Heavy incidence of pest, higher cost of inputs and low consumer acceptability and storage quality of the grain and low fodder content are among the factors accounting for the low coverage under hybrid jowar. Absence of hybrids suitable for rabi areas is another factor. Recently, trials at the International Crop Research Institute for Semi-arid Tropics (ICRISAT) at Hyderabad have shown that a predominantly rainfed

crop, with one or two sprinkler irrigations during times of stress, yields about 2 to 3 tonnes/ha. Good rain water management in July and August and irrigation support from other sources should help to increase jowar yields. Hybrids have an advantage of tolerating pressure of plant population, which should be utilised for increasing production of jowar per unit area. It is necessary, therefore, to evolve medium duration varieties with high response to fertilisers. Sown in time, hybrids need very little plant protection. However, measures are necessary to combat striga (a parasite).

6.2.22 Rajasthan and Gujarat account for half the country's bajra area and production. Since the yields are low in Rajasthan because of very low rainfall, it has been suggested that the areas under bajra should be diverted to fodder grass. Since the hybrids are highly susceptible to diseases, farmers are reluctant to accept the new varieties. This needs attention. A judicious agronomic management of the tillering characteristic of the hybrids is needed. Similarly, direct transplanting of seedlings, under conditions of late onset of rains, which gives appreciably higher yields over direct sowing, helps not only in stabilising yield but also in reducing the seed rate. Dry sowing of bajra is also found to give good germination and stand when rains are received. A difficulty is, however, the bird menace. Improvement of grain quality providing for improved digestibility and keeping quality should help in developing better bajra varieties even from the nutritional point of view. Concerted efforts are, therefore, needed to develop high yielding, disease and bird resistant varieties together with appropriate agronomic methods including transplanting and dry sowing to improve yields. With yields increasing to $2\frac{1}{2}$ times the present yield level of 0.50 tonnes/ha, the production of bajra in 2000 AD will be 15 million tonnes.

6.2.23 Ragi is mainly the crop of the peninsula, being important in southern parts of Karnataka, but is also grown in Uttar Pradesh, Maharashtra, Bihar and Orissa. In dry areas, ragi is preferred to bajra because of better yields. Hybrids have been attempted in ragi to combine the white grain characteristics with high yield and a few varieties have been released for cultivation both in Tamil Nadu and Karnataka. Still, there is scope to increase yield if short duration varieties to suit the two-crop and three-crop rotations could be evolved. Since ragi does not mature uniformly, breeding for uniform maturity is desirable. It is lacking in seed dormancy which needs to be introduced. In developing new varieties, the need to minimise post-harvest losses has to be kept in view. With these measures, it should be possible to raise yields to $2\frac{1}{2}$ times the present yield of 0.84 tonnes/ha and achieve a production of 5.25 million tonnes in 2000.

AD by keeping the area at 2.5 Mha as at present.

6.2.24 Small millets are poor yielding crops grown in the peninsula and also in the hills. The grains are generally consumed by the poor, including the tribals, and are used for livestock feed, especially birds. In the field of research, these have been neglected. Future research programmes of small millet crops should be developed separately for grain and fodder purposes. Since these crops are grown both in the heavy and low or scanty rainfall regions, research efforts should be directed to see if their requirements with regard to varieties and agronomic practices are different under different conditions. Out of the total existing area of 4.7 Mha under small millets, 2.7 Mha may be diverted to fodder crops and only 2 Mha be retained for grain production.

Pulses

6.2.25 Pulses, besides being a source of protein for the population, are also important in livestock feeding. The potential for the use of pulse legumes as well as forage legumes in maintaining soil fertility is also great in the country. Attention is, therefore, necessary for their improvement and a substantial increase in their production.

6.2.26 Pulses occupy 22 Mha and account for 11 million tonnes of grain. The most widely known grain pulses are gram and pigeon pea. Kharif pulses (pigeonpea and others) account for 41 per cent of the area and 30 per cent of production, the rest being occupied by rabi pulses. Pulses have been neglected in research and development programmes so far.

6.2.27 Gram accounts for the bulk of area (35 per cent) and production (46 per cent) among all pulses. The crop is irrigated to the extent of 20 to 25 per cent in Uttar Pradesh, Punjab, Haryana and Rajasthan. Being a low temperature crop, its area distribution approximates to that of wheat. Separate varieties and growing techniques need to be developed in the peninsular parts where yields are low. Improvement of yield in gram can be achieved by breeding better varieties and providing for at least one irrigation between sowing time and flowering date depending upon exigencies.

6.2.28 Pigeonpea is cultivated in all parts, the concentration being in Madhya Pradesh, Maharashtra and Uttar Pradesh. The yields in the peninsular region are low compared with that of north. Efforts have to be made to develop medium duration single-season high yielding varieties suitable for different parts and resistant to frost and wilt.

6.2.29 In regard to other pulses, due attention is required to be

given to black gram, green gram, horsegram, *moth* and many others like cowpea, frenchbean, *dolichos lablab* in order that they could be grown in different conditions of rainfall and soil in different parts. Rainfed techniques have to be given utmost importance in research and development activities. The agricultural universities and State Departments of Agriculture will have to draw up their own strategy concerning typical problems in regard to the pulses of their respective regions. The extension machinery should give top priority to make available to the farmers the existing knowhow and the needed inputs.

3 COMMERCIAL CROPS

Oilseed Crops

6.3.1 Oils of vegetable origin are derived not only from the oilseed crops but also from cotton seed, rice bran, maize (corn), coconut, oilpalm and oil bearing herbs, shrubs and trees. Among the new crops, soyabean and sunflower indicate good promise. The already established crops are groundnut, sesamum, niger and castor in the kharif season and brassicas, linseed and safflower in rabi. In terms of area, groundnut is the most important crop, brassicas, sesamum and linseed being the others in the same order. Groundnut, brassicas, sesamum, safflower and niger oils are used mainly for edible purposes while linseed and castor oils are used for non-edible purposes—linseed for paints and castor for lubrication. The consumption of these oils is expected to increase so much that increased production of the crops will have to be achieved by increasing yields as well as the area under these crops.

6.3.2 Comprehensive research work into the different aspects of improvement of oilseed crops has been undertaken not only by the Central institutes, universities and the Departments of Agriculture but also under All India Coordinated Research Project on Oilseeds started in 1968. The results of research have helped to (a) increase genetic variations by evolving high yielding varieties and hybrids of oilseeds; (b) develop foliar application of nitrogenous fertilisers to groundnut and mustard in unirrigated areas; (c) increase yields of groundnut and quality of kernels through the application of gypsum, zinc, boon and periodical application of lime in soils with low pH; and (d) draw effective plant protection schedules against pests, diseases and weeds. In regard to groundnut, rapeseed, mustard, linseed and castor, the Directorate of Oilseed Development has drawn up programmes to introduce these research results in the package of practices recom-

mended to the farmers. But, in all these programmes there is too much emphasis only on two crops, namely, groundnut and brassicas. Due attention should, therefore, be given to all oilseed field crops in order to increase their production capabilities. Many of the known results of research should be extended to them immediately and in the case of groundnut and brassicas, extension efforts should aim at covering the entire area with useful practices as quickly as possible. The breeding programmes as well as plant protection work have also to be intensified since most of the oilseed crops are affected by several pests and diseases in the field as well as in storage which need specific remedies.

6.3.3 Gujarat, Andhra Pradesh, Tamil Nadu, Maharashtra and Karnataka are the major groundnut producing States with Madhya Pradesh, Uttar Pradesh, Punjab, Rajasthan and Orissa having limited areas under the crop. The performance of the crop reveals that in high rainfall areas it suffers because of excessive moisture and lack of drainage and the yield is depressed. In the lower rainfall areas the crop needs irrigation support to increase yields to the level of the national average. Apart from the rainfall situation, the fact that cultivation of the crop has been extended to less fertile and marginal lands, where the soil factor acts as a constraint, is chiefly responsible for the decline in yield levels from 1.2 tonnes/ha in the twenties to about 0.5 to 0.8 tonnes/ha at present with the national average at 0.78 tonnes/ha. Keeping in view the fact that groundnut crop is already occupying about 7.5 Mha and that it has been extended to unsuitable areas, substantial area increases are not possible. The major areas under groundnut will have to continue under rainfed conditions only. Because of this, the extension of area under groundnut should be effected as far as possible in areas which receive rainfall of 10 to 20 cm per month in three or all of the south west monsoon months of June to September or where it is 20—30 cm per month in two of these four months or in the south where the rainfall of September to November ranges between 5 and 20 cm per month. Further, as it may not always be possible to allot the best lands to groundnut, agronomic techniques should be developed to give maximum possible returns under different kinds of soils. The crop should be given an early start in the kharif season with the help of irrigation, at least in some project areas. In order to raise the yield level, it is necessary (a) to develop better drainage in fields in high rainfall areas; (b) to take all possible measure for conserving soil moisture in low rainfall areas; (c) to adjust growing season to fit into local rainfall rhythm; and (d) to increase the plant population per unit area. With these measures it should be possible to improve on the yield of 1.2

tonnes/ha already attained and achieve the yield target of 1.5 tonnes/ha in 2000 AD.

6.3.4 All the States which grow groundnut grow sesamum as well, the former being concentrated in the peninsula and latter in the northern States of Rajasthan, Uttar Pradesh and Madhya Pradesh. The crop is taken rainfed everywhere. The crop suffers in areas of excess rainfall in Uttar Pradesh and Madhya Pradesh due to lack of drainage. It does well in moderate conditions of rainfall. The area increase in sesamum crop should, therefore, take place in such rainfall zones where the southwest monsoon months involve rainfall of 10 to 20 cm or 20—30 cm for at least one month. There is scope for substantial increase in the yield level of this crop by improving drainage conditions in high rainfall areas and better use of rainfall elsewhere.

6.3.5 The States of Madhya Pradesh, Bihar, Orissa and Maharashtra account for 90—93 per cent of the area and production of niger crop in the country. Madhya Pradesh has about 50 per cent of the all India area but the yield is only 0.18 tonne/ha, the all India average being 0.24 tonnes/ha. The yields can be increased by introducing the high yielding Ethiopian varieties directly after testing or used for improvement of the Indian varieties through hybridisation. The area under niger should be increased by extending cultivation to wheat fallows in Madhya Pradesh.

6.3.6 Uttar Pradesh alone accounts for about 65 per cent of the all India area under the brassicas group of oil bearing crops. The cultivation of brassicas is confined to the wheat belt, the wheat-brassica mixture being the prevalent crop-combination. Where a pure crop is taken, it is irrigated, as in Maharashtra, Haryana and Punjab. Extension of irrigation facilities to at least 50 per cent of the total area of the crop, particularly in Uttar Pradesh, will help in doubling the yield level which is only 0.5 tonnes/ha at present.

6.3.7 Maharashtra has the largest area under safflower followed by Karnataka and Andhra Pradesh. It is usually taken on dry land but comes up well under irrigated conditions. It can suit paddy fallows in majority of the paddy growing areas. It can be a fit substitute to lathyrus in Madhya Pradesh, Bihar and West Bengal.

6.3.8 Soyabean is rich in protein and has an oil content of 15 to 20 per cent. Its cost of cultivation is high because of high seed rate and high cost of seed. Although the Government is subsidising the cost of seed and the insecticides, the crop should be developed purely on the basis of economics and utility. In fact, it has to be sustained by the oil and soyabean market. In extending the area under soyabean, additional avenues of soyabean utilisation will have to be found

out. Soyabean can be considered as one of the substitute crops in such areas where rainfall, though high, is not adequate for paddy. It can be considered without irrigation even in other situations in preference to pulses like horsegram. For popularising soyabean, indigenous hilly varieties can be introduced as an alternative to the exotic varieties since the horsegram is used as a pulse by the hill population, an advantage the latter does not have. Research work is necessary to introduce disease resistant new varieties, particularly those resistant specifically to mosaic.

6.3.9 Oil rich sunflower varieties have an oil content of 45—50 per cent. The crop is of short duration of about 90 days and can be raised at any time of the year under irrigated as well as unirrigated conditions. It yields high (3.9 tonnes/ha) with irrigation. The seed setting and seed viability are low. The seed setting is found to improve with increasing bee-pollination and by making bee-keeping a necessary accompaniment to sunflower cultivation, as in Russia. This has to be studied with extensive experimentation under Indian conditions. Alongside, the problem of seed viability should also be studied. The oil content of seed can also be improved through proper breeding efforts. The crop is bound to become popular in future. Out of the total area of 2.0 Mha under sunflower, only 0.75 Mha can be put under irrigation. The rest will have to be raised under rainfed conditions as an early kharif crop in general (wherever possible) and late kharif crop with the help of September-October rains in the south.

6.3.10 India is one of the major producers of castor seed, ranking next only to Brazil, and accounting for 28 per cent of world production. In the years to come, castor will be increasingly required for rearing silk worms. It is necessary to increase both the area and yield by introducing short duration varieties of this crop. Similarly, there is need to increase the yield of linseed crop which occupies an area of about 2 Mha.

6.3.11 The intake of oilseeds by the crushing industry depends on the full utilisation of oilseed cakes. Cotton seed and rice bran, which should be utilised for extracting oil, are at present used for livestock feeding. The extension agencies should popularise the use of oilseed cake for livestock feeding instead of oilseed. Similarly, efforts should be made to feed the livestock with de-oiled rice bran rather than the oil bearing rice bran. The full utilisation of cake or meal of all the oilseeds in general is an imperative necessity because failure to utilise cake will discourage the intake of oilseeds for crushing and thereby adversely affect the cultivation of oilseed crops. Utilisation of cakes as manure and for preparation of germicides and pest repellants may be developed and popularised. Internal demand and export may be

properly balanced so that annual fluctuations in the quantity exported are avoided as far as possible.

6.3.12 The subject of oil crops and oil bearing vegetation is at present dealt with in an uncoordinated manner. For giving proper attention to oilseed crops there is need for four well-coordinated wings, one each to deal with (a) field crops; (b) subsidiary oil bearing products of field crops; (c) oil bearing shrubs and trees; and (d) byproducts of oil industry. These wings may be set up both on the research and production side, i.e. in the ICAR as well as in the Union Ministry of Agriculture and Irrigation. A similar operational set up may be created in the State Departments of Agriculture with the due participation of the agricultural universities on the research side. It is also desirable that a Central technological laboratory for oilseeds and their byproducts is set up under the ICAR.

6.3.13 Oilseeds are grown under such diverse conditions that any general all India coordination of the type that is at present attempted makes it difficult to give attention to specific problems of each State. It is necessary that each State should be fully responsible for research as well as developmental work in oilseeds in their respective regions. Regional Coordination should, in the first instance, be organised among the contiguous States having identical crops and identical problems. The Central coordination should be confined to problems of all India nature with the Oilseeds Development Council at the Centre being made broadbased apex body charged with this responsibility. Its composition should include representatives of the States, ICAR, Union Ministries of Agriculture and Irrigation, Industry and Civil Supplies and Commerce, Forest Research Institute, Dehra Dun, Khadi and Village Industries Commission and oil millers. The States may also have similar apex bodies with representatives from agricultural universities, Departments of Agriculture, Horticulture, Forests and Industries, Khadi and Village Industries Board and representatives of oil industry and growers. It is this body which could represent a State on the Central apex body as well as in the Interstate coordination council.

Sugar Crops

6.3.14 Among the sugar yielding crops like sugarcane, sugar beet, palms and sorghum, sugarcane is the most important being used in the manufacture of sugar, *khandari* and gur. Sugarcane is grown almost in every part of the country except in extreme north and high hills. Ninety per cent of its area and production is in eight States—four in the north comprising Bihar, Uttar Pradesh, Haryana and Punjab and four in the peninsula namely Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. Uttar Pradesh accounts for 51 per cent of area and

43 per cent of production. Yields are, however, much higher in the peninsula than in other parts, being 60 tonnes/ha on an average in Maharashtra, 81 tonnes/ha in Tamil Nadu and 90 tonnes/ha in Karnataka, compared with 40 tonnes/ha in Uttar Pradesh and 30 tonnes/ha in Bihar.

6.3.15 Practically all the States resort to ratooning, particularly Uttar Pradesh and Bihar. The yield of plant crop in the reserved area of Uttar Pradesh has been of the order of 45 tonnes/ha whereas the ratooning crop has yielded on an average only about 33 tonnes/ha. Ratooning is necessary to bring down the cost of cultivation and should be encouraged because, being early, the ratoon crop can feed the factory earlier than the plant crop. The ratoon crop has to be given as much attention as the plant crop and separate agronomic and plant protection schedules should be drawn up for each. So far the emphasis in breeding has been to produce varieties suitable for white sugar and not so much for *gur* or *khandsari*. Varieties have to be bred separately for (a) plant and ratoon crops and (b) *gur* and white sugar varieties for highest possible sugar recovery, tillering capacity and tolerance to high population stress. Agronomy has to aim at maximum percentage of germination, least mortality and the maintenance of an optimum plant stand up to the end. In the field of plant protection, efforts have to be continued for introducing genetic resistance and for finding out effective methods of chemical control while biological methods of control also require to be developed and put into practice. Biochemical techniques should be developed for stimulating ripening in adverse circumstances.

6.3.16 It is necessary that research activities other than breeding should be made the responsibility of the agricultural universities in order to effectively solve the regional problems. Since sugarcane breeding presents a special problem, viz., that of flowering, the Sugarcane Breeding Institute, Coimbatore has to continue to play a central role in hybridisation work and serve as an all India centre. The Hebbal Station of the University of Agricultural Sciences, Bangalore should be developed as a companion station to Coimbatore to cater specially to the needs of the south so that Coimbatore can devote more time to the problems of the north. The Sugarcane Research Institute, Lucknow has to develop as a sister station along with Coimbatore specialising in selection and development of suitable varieties after the 'fluff' stage for the northern parts of the country.

6.3.17 Sugarcane development work is by and large confined to the factory areas where sugarcane is grown exclusively for the manufacture of white sugar with the result that development of sugarcane in other areas has throughout been neglected. This has led to the neglect of seed, irrigation, manure and plant protection schedules for sugarcane

cultivation. The seed material in circulation is highly degenerated and disease ridden. It is necessary to give special attention to the multiplication and distribution of disease-free planting material and streamline the distribution channel.

6.3.18 An integrated approach to sugarcane development covering white sugar, *gur* and *khandsari* production is called for. The developmental activities in the field of sugarcane should be the responsibility of the Director of Agriculture on a uniform pattern in all the States including Uttar Pradesh. Even the industrial aspect with regard to production of sugar or *gur* or *khandsari* may be looked after by the Department of Agriculture by creating a special cell for the purpose. Sugar factories should be encouraged to participate directly in promotional and advisory activities on the developmental side as much as in procurement activities in their respective areas. It should be mandatory for the factories to have a cane development wing for this purpose. Such a wing in every factory should have a Cane Development Officer in the same way as a Chief Chemist or Chief Engineer. Its functions should relate to the provision of inputs, including credit in factory areas and advising growers on all aspects of sugarcane cultivation. It should have mechanical units available for operation on the growers' fields on payment of appropriate charges. Thus, a very effective and intimate two way contact between the grower and the miller should develop. Governmental involvement in these matters should be limited to a supervisory role.

6.3.19 Research and development efforts properly organised should help improve yield levels throughout the country. There is more scope in this regard in the north than in the south. The target yield level would be 75 tonnes/ha in the north and 100 tonnes/ha in the south. About a million hectares of additional area can be brought under sugarcane in the peninsula and about 1.5 Mha in other parts. Uttar Pradesh and Bihar can take in more area but the needs of other promising State like Madhya Pradesh, Orissa and irrigated areas of Rajasthan should be given due consideration.

6.3.20 The cultivation of sugarbeet is at present confined to two factory zones, viz., Sriganganagar (Rajasthan) and Phalton (Maharashtra) where it is processed on a semi-commercial scale. The Government of Jammu & Kashmir has launched a modest beet cultivation programme in farmers' fields with a view to setting up a beet sugar plant in the State. The sugarbeet programme is proposed to be extended to more factories in Punjab, Haryana and Uttar Pradesh during the Fifth Plan period. It can be specially considered in the north western parts comprising Jammu & Kashmir, Himachal Pradesh, West Uttar Pradesh, Punjab, Haryana and Rajasthan.

Tobacco

6.3.21 Commercial cultivation of tobacco is concentrated in Andhra Pradesh, Karnataka and Gujarat, which together account for 80 per cent of area and production. Andhra Pradesh alone accounts for 48 per cent of the area and 45 per cent of production. The northern States of Uttar Pradesh, Bihar, Orissa and West Bengal account for 16-17 per cent of area and production. The crop is unirrigated in Andhra Pradesh, Karnataka and Maharashtra and irrigated in Gujarat, Tamil Nadu and in most northern States. Yields are the highest in Gujarat and Tamil Nadu and in most northern States. They are the highest in Gujarat and Tamil Nadu (1.5 tonnes/ha) and between 0.7 and 0.9 tonnes/ha in the north, 0.8 tonnes/ha in Andhra Pradesh and 0.5 tonnes/ha in Karnataka.

6.3.22 Andhra Pradesh has specialised in the production of virginia tobacco. Karnataka and Maharashtra also have small areas under this variety. Gujarat, Karnataka and Maharashtra are the important States producing *bidi* tobacco. Parts of Bihar, West Bengal and Uttar Pradesh grow *hookah* tobacco while the south Tamil Nadu area of Madurai and Coimbatore grow chewing, snuff, filler and binder tobaccos for cheroots.

6.3.23 Virginia tobacco has received the best of attention in regard to both research and development, since it has to feed the cigarette industry in Britain as well as the developed cigarette industry in India. The Government of India has also evinced interest in the development of virginia tobacco because of its contribution to revenue and foreign exchange earnings. A Tobacco Export Promotion Council was established in 1956 to promote exports.

6.3.24 Future research on tobacco should be in the direction of achieving higher yields per plant and per unit area of land under all kinds of tobacco. Aircured and or aromatic tobaccos like burley, *Natu* and *Lanka*, which have better appeal in the export market need encouragement. The agricultural universities in the tobacco regions should be increasingly associated in future research work. Some specific aspects which require investigation are : (a) avoidance of harmful effect of irrigation on leaf quality due to the presence of chemicals in irrigation water; (b) biological control of pests and role of harmless chemicals for use in plant protection work e.g. fungicides of organic origin, and (c) elimination or reduction of carcinogenic or other harmful properties of tobacco.

6.3.25 Grading of tobacco leaves should be made compulsory irrespective of whether the product is meant for export or for internal consumption. The system of grading tobacco leaves according to position plant should be investigated with due regard to the economic

operation of the barns. The Ministry of Agriculture and Irrigation together with the concerned State Governments should make a review of all developmental activities, including extension and training, in order to make the development organisation effective in every tobacco growing district for increasing production of all kinds of tobacco.

Cotton

6.3.26 Gujarat and Maharashtra are the major cotton growing States accounting for 57 per cent of the all India area. Madhya Pradesh and Karnataka come next with 22 per cent of the country's cotton area. Except in Gujarat, the yield levels in the main cotton region are low, being 45 to 65 per cent of the all India average. Where the crop is supported by irrigation, as in Punjab, Haryana, Rajasthan, Uttar Pradesh and Tamil Nadu, yields are high, being above the national average. A study of 80 principal cotton growing districts in the country in relation to rainfall and irrigation facilities reveals that nearly 60 per cent of districts (with 66 per cent area) in the main cotton belt of Gujarat, Madhya Pradesh and Maharashtra lie in the high rainfall areas. Most of the districts have less than 10 per cent of cotton area under irrigation. The yield performance of the crops is not uniform. While yields in Gujarat districts are good (115 to 160 per cent of all India), the districts in Madhya Pradesh and Maharashtra record low yields (less than 70 per cent of all India). The insufficiency or irrigation does not wholly explain the low performance in Madhya Pradesh and Maharashtra. Judged by the better performance of Gujarat, which can be attributed to effective water management and the attuning of the crop to the rainfall rhythm, there is no reason why the crop is not able to perform well under similar rainfall distribution in Madhya Pradesh and Maharashtra. This problem needs to be studied by the agricultural universities and the State Departments of Agriculture in both the States. The districts of poor performance where rainfall is insufficient and irrigation support is needed, are : Aurangabad (Maharashtra), Belgaum, Gulbarga, Dharwar, Bijapur, Raichur, Bellary, Chitradurga (Karnataka) and Mahboobnagar, Kurnool and Anantpur (Andhra Pradesh). Raising of cotton crop in these districts should be based on a judicious exploitation of rainfall supported by supplemental irrigation in times of need during the pre-monsoon and post-monsoon months.

6.3.27 The demand for cotton is expected to rise considerably requiring an increase in area by 4 Mha with an increase in area under irrigation from the existing 16 per cent to 65 per cent of total area in 2000 AD. The districts of west Uttar Pradesh have the same promise for cotton growing as in Punjab and Haryana. Cotton grow-

ing may also be encouraged in West Bengal, Bihar and Orissa.

6.3.28 The emphasis in cotton production has all along been on cultivating exotic cottons of superior quality. As a result of State policy, the cotton textile industry has undertaken production of coarser yarn and cloth using medium and short staple cottons. The export market, which is competitive, is in favour of long staple and superior medium staple cotton. India is in a favourable position with regard to coarse cotton, which is not produced by other countries, and production of coarse cloth in which the competition is less. In the circumstances, it is necessary to make a periodical review of domestic and export demands in order to determine the proportion of long, medium and short staple cotton which India produce to support its production programme. Since it is likely that more of medium and short staple cotton may be required in future, suitable high yielding varieties of these cottons will have to be bred for the purpose.

6.3.29 Research on cotton has resulted in appropriate agronomic and plant protection schedules for different cotton growing areas in the country. What is needed is that research results of practical value already available should be sifted regionwise and formulated into suitable agronomic and plant protection schedules, so that a substantial increase in yield levels could be achieved. In addition, adjustment of cropping seasons may be considered to take advantage of insect and disease free periods on the same lines as the "potato seed plot technique". Crop protection schedules adopted individually by cotton growers are not as economical or effective as when practised cooperatively on a large scale. Cooperative pest management practices involving the whole village community should be encouraged. Future research programme should lay emphasis on integrated methods of control, including biological control, which should be developed and popularised. Research should be directed to evolve special varieties which can withstand the effects of high soil moisture in high rainfall conditions, particularly in the months of July and August. Short duration varieties will have to be bred for the development of cotton in the Sundarban. Similarly, varieties will have to be evolved and suitable agronomic and plant protection techniques developed for cultivating cotton during the months of December to April in other parts of West Bengal and adjoining States of Bihar and Orissa. Breeding work should also take into consideration the special requirements like : (a) varieties with a gossypol free seed; (b) varieties with increased oil content of seed without detriment to the quality or quantity of lint and (c) varieties with fibre suitable for blending with synthetic fibres. The Cotton Technological Laboratory should continue to study all facets of fibre quality

and treatment which will promote the use of cotton varieties for blending purposes and incorporate easy-care characteristics even in pure cottons.

6.3.30 In the future, every State should tackle its own research and developmental problems with the involvement of the agricultural university and Department of Agriculture. For purposes of inter-State consultation and cooperation, the important cotton growing States can be formed into groups. The Central Cotton Research Institute, Nagpur, has to develop a working partnership with the concerned agricultural universities for solving the regional problems.

Bast Fibre Crops

6.3.31 Bast fibres; like jute, mesta, ramie, sannhemp, flax and agave, are put to a variety of uses viz., packing, flooring, furnishing and backing material, woollenised fabrics, fishing nets and lines, marine and industrial ropes, twines, cardages, cables etc. Jute and mesta will have to face severe competition from synthetics. Even so they have an advantage in their cheapness, strength and stability. The advantage of comparatively low price of jute and allied goods has to be maintained by paying continuous attention to productivity, this being the only way to save this crop against competition from other sources. New uses of jute and allied fibres such as textiles, flooring and construction materials and woollenised goods should receive constant attention.

6.3.32 West Bengal, Bihar and the northeastern region comprising Assam, Meghalaya, Mizoram and Tripura account for 92 per cent of jute area in the country. West Bengal alone accounts for 56 per cent of total area. Rainfall during the monsoon months appears adequate for the jute crop which is not irrigated to any appreciable extent. Only about 5 per cent of total area is irrigated in West Bengal. Inadequate rainfall during the months of April and May has an adverse affect on overall yield levels. It is necessary to provide assured irrigation during these months. Riverine floods adversely affect the crop in Saharsa and Purnea districts. Since irrigation is at present the most important factor for increasing jute yields, an area of 0.8 Mha ie, 80 per cent, out of the proposed 1 Mha under jute should be irrigated. Out of the remaining 0.2 Mha, 0.1 Mha may be brought within a more assured rainfall distribution, which, in practice, involves sowing not later than the 15th May. This may be tried on an experimental basis and, for this purpose, early maturing varieties may be used.

6.3.33 There is adequate information available through research work, the results of which should be utilised in effecting yield im-

provements. The real bottleneck is, however, the slow pace of development and extension activities. Although the jute development programme was launched under the Second Five Year Plan, a well conceived jute development policy took shape only during the Fourth Plan and sustained efforts to increase yields through increased use of recommended inputs were made thereafter. The Fifth Five Year Plan has a programme of improving production through (a) increasing irrigated area; (b) supplying lime at subsidised rates for neutralising acidity (c) increasing coverage under improved varieties; (d) improving fertiliser distribution and adoption of plant protection measures; and (e) improving extension services to propagate improved practices based on available research results. With these measures, the yield is expected to go up to 2 tonnes/ha.

6.3.34 It is necessary to ensure that certified seed is made available in adequate quantities to the farmers so that more area can be brought under improved varieties. Farmers prefer to have fresh seed every year for raising a fibre crop. But, research results indicate that the fibre crop can be raised from two year old seed provided germination is not impaired below 80 per cent. Developmental measures should be intensified in order to bring home to the farmer the full benefits of research work and provide him with all necessary inputs.

6.3.35 West Bengal, Bihar, Orissa and Assam account for 45 per cent of area and 59 per cent of production of mesta. Andhra Pradesh and Maharashtra between them account for 43 per cent of area and 35 per cent of production. Andhra Pradesh has the largest area of 89,000 ha (28 per cent) with West Bengal coming next with 61,000 ha (19 per cent). In Andhra Pradesh, mesta is grown as a single crop and in other States as a mixed crop with jowar, bajra, rice and cotton and also as a border plant in sugarcane and maize fields. The crop grows well in all areas where jute is raised with an added advantage that it thrives even without irrigation. Serious attention to the mesta crop came to be given in the wake of partition when substitutes had to be found for the jute crop.

6.3.36 The all India average of mesta yields is 6.6 quintals/ha. The yield is the highest in West Bengal at 10 quintals/ha. The crop has received the attention of the Jute Agriculture Research Institute (JARI) and the results of research into improved techniques of cultivation have been incorporated in the package of practices recommended to the farmers. It is possible to step up the yield to 15 quintals/ha in the eastern States of West Bengal, Bihar and Orissa and in the northeastern region and to 10 quintals/ha in Andhra Pradesh and 9 quintals/ha in other States. In order to achieve these yield levels, each of the States concerned should develop their own research pro-

grammes through their agricultural universities. JARI should play a coordinating role, while continuing to deal with the technological aspects of production.

6.3.37 The early efforts at raising the ramie plantation in Bihar and Assam made by several European firms in the later part of the 19th century did not succeed because of faulty methods of cultivation and difficulties of fibre extraction in the absence of suitable decorticating machines. After the Jute Agricultural Research Institute, which deals with the technological aspects of ramie production, has fabricated a decorticating machine suitable for the ramie fibres, the latter difficulty has been overcome.

6.3.38 Areas of high rainfall and warm humid climate are suited to ramie crop. Ramie plantation may be established in the Himalayan West Bengal, Assam and other suitable parts of the northeastern States. It can be tried even along the west coast. Being a plantation crop, it requires heavy investment to begin with. It also occupies field for 6 to 8 years. The advantage of starting these plantations could be given to the small farmers by allotting compact areas and encouraging them to form cooperatives. Since the ramie plant is propagated through rhizomes, arrangements should be made to produce the requisite quality of seed material. The JARI and the Central Ramie Research Station, Sorbhog should continue to be responsible for research on ramie for the time being.

6.3.39 Uttar Pradesh is the major sannhemp growing State accounting for 36 per cent of the all India area and production. Madhya Pradesh comes next with 18.7 per cent of area and 16.1 per cent of production. The crop has not received adequate research attention so far. The impact of research work done at Pratapgarh and by the JARI on the varieties grown and the improved practices adopted is not perceptible. It is necessary that the States growing sannhemp should undertake direct responsibility for research through their agricultural universities. The JARI should coordinate between regions and deal only with the technological aspects.

6.3.40 The important problems that need attention are the breaking up of the barrier of self-sterility and bringing forth durable hybrids of synthetics, breeding of varieties separately for purposes of green manuring and for fibre and the special measures which are required to be undertaken under the seed multiplication programmes to ensure that deterioration, which is inherent owing to cross pollination in course of time, does not affect the quality of seed meant for cultivation.

6.3.41 Commercial cultivation of agave is still very limited and the existing plantations are in a neglected state being raised in poor soils and largely uneconomic. There are at present about 3,000 hectares of agave plantations in the country distributed over Orissa (120 ha),

West Bengal (410 ha), Andhra Pradesh (579 ha), Maharashtra (726 ha), Madhya Pradesh (50 ha) and Bihar (30 ha). The annual production is estimated at 25,000 tonnes.

6.3.42 A good agave plant needs at least 78 cm rainfall well distributed over the year, and a plantation to be successful has to be compact and sufficiently large. Keeping in view the considerations of economic viability and the need to renew the plantation once in 10 years when agave flowers die out, the minimum size of plantation in India should be 105 ha so as to ensure continuity of production. The land ceiling laws in the States leave little scope for individual ventures of this size. Such plantations should, therefore, be organised on cooperative lines by small enterprising farmers. Because of the agronomic and decortication techniques involved it will be a fit venture for agricultural graduates to undertake. Preference should, therefore, be given to the agricultural graduates in establishing agave plantations.

6.3.43 Agave cultivation has grown largely on the basis of knowledge developed in other countries. The Central Sisal Research Station, Bamra (Orissa), set up in 1962 on the recommendation of the Expert Subcommittee of the Indian Central Jute Committee (ICJC), should continue the basic work being done there to provide the required research support to this crop, which had been very little before. The Ministry of Agriculture and Irrigation should take steps to see that the area target of 20,000 hectares, recommended by the Subcommittee to increase the production of agave fibre, is fulfilled.

6.3.44 One of the bottlenecks in the expansion of area is the non-availability of adequate quantities of planting material. Since the Research Station at Bamra is not able to meet full requirements of the States, nurseries should be established in every State by the Departments of Agriculture so that the States might become self-sufficient in seed material. These nursery stations can also undertake adaptive research in their respective regions while the Research Station at Bamra should continue to concentrate on basic research problems only, without directly involving itself in seed multiplication. The ICAR Institutes should lay emphasis in research for breeding varieties which give increased outturn, better quality of fibre and also varieties resistant to pests and diseases. Seed setting in agave requires a cool climate. The ICAR should choose a suitable station for this purpose at a higher altitude. Because the land which will be available for this crop will be mostly marginal or sub-marginal, improvements in its productivity should receive attention in research programmes. Arrangements may have to be made to obtain the know-how from other countries advanced in the cultivation of this crop. The Central Arid Zone Research Institute at Jodhpur and the University of Udaipur

or any other agricultural university which may be established in Rajasthan, should undertake the responsibility for research work for the propagation of agave in dry conditions.

4 HORTICULTURAL CROPS

Fruit Crops

6.4.1 The area under fruits, fresh and dry, is estimated to be between 1.5 and 1.8 Mha. It is considered possible to raise it by two and a half times to about 4 Mha in 2000 AD. It is also possible to double the present yield levels and increase fruit production by more than four times in 2000 AD, thereby meeting not only the rapidly rising internal demand but also creating substantial export surpluses to take advantage of the potential foreign demand for different types of fruits.

6.4.2 Expansion of fruit cultivation requires the backing of an organised multiplication and distribution programme for the planting material. Keeping this in view the establishment of a chain of progeny orchards covering breeder, foundation and certified seed stages alongside measures to regulate the multiplication and distribution of planting material through progeny orchards has been recommended in Chapter 10.

6.4.3 The menace of birds and monkeys is a serious problem faced by the seed growers. The problem has arisen from an ecological imbalance created by indiscriminate destruction of forests, following which animals had been denied their natural habitat. The long term and scientific solution lies in restoring the natural balance. The ICAR should undertake research on the maintenance of ecological balance in the context of minimising damage to fruit crops through animals and birds.

6.4.4 As fruit cultivation expands together with the growth of vegetable and other horticultural crops, measures will be needed to promote and organise related activities of extension and development. The States should, therefore, strengthen their horticultural set up to effectively undertake the expansion programmes relating to fruits, vegetables etc. The impact of land ceiling laws on the size of fruit groves and orchards is likely to be an important factor influencing the farmers' decisions in regard to the area to be brought under fruit crops. It will be necessary to collect data through scientifically laid out experiments on the minimum economic size of an orchard and also the comparative economics of raising a food or commercial crop *vis-a-vis* a fruit crop and make such information available to the farmers so that

they could decide on the area to be brought under fruits Specific measures may be required in future to induce farmers to put at least a part of their holdings under fruits. It may also be necessary to give special loans to induce farmers to take to fruit cultivation.

6.4.5 Mango groves and orchards lie scattered throughout the country, the orchards of grafted mangoes being confined to places near about marketing areas, while groves of seeding mangoes lie spread throughout the rural areas. The groves of seedling or mango have become old and remain in a neglected state. The fruit of the seedling trees comes to the market later in the season, thereby extending the season of availability up to August. Seedling mango trees should be protected and the area under them also increased. The felling of such trees has to be regulated so that only useless trees are cut and a correct proportion is maintained between removal and replenishment. Seedling mango should receive continued attention in future research and development efforts. The method of top-working can be profitably applied to seedling mango trees of 30 years or under in areas well connected to market places. The objectives should be to favour orchards of grafted mango in areas close to the market and concentrate on seedling mangoes in the interior. For top-working as well as ordinary grafting, it is necessary to train a large number of *malis* in the art of budding and grafting so that they can operate an effective custom service. A vigorous extension programme will also be necessary to educate people to replace inferior trees and groves.

6.4.6 Grafted mango orchards need more attention so that the area could be doubled. Community lands like those of the panchayats and the areas released from shifting cultivation in the States of Madhya Pradesh, Bihar (South) and the adjoining areas in Orissa can also be considered for mango planting. Road and canal sides also afford possibilities for this purpose. It is worth studying the comparative merits of planting road and canal sides with mangoes and other trees in order to determine the relative feasibility and proportion of various interplants. On the research side, hybridisation efforts illustrated by the evolution of *Mallika* for incorporating the characteristic of annual bearing has to be pursued tenaciously until it becomes possible to release a good number of hybrids capable of bearing annually. Similarly, research efforts to eliminate or control malformation of vegetative and floral shoots need intensification.

6.4.7 For the mango crop, the available scientifically improved varieties are very few, as almost all the Indian varieties are the result of local selections made in the past. The commercial varieties, which are under cultivation, require to be screened from the view point of genetics, and once the cultivars with stable and identical characters relating to plant behaviour, productivity, disease resistance, adaptabi-

lity, quality and flavour have been identified, only these should be propagated vegetatively on standardised rootstocks. Use of polyembryonic rootstocks would further ensure uniform performance. Breeding efforts have also to continue for evolving better varieties, incorporating desirable characters such as dwarfness, resistance to pests and diseases and different maturity periods. Some polyembryonic varieties have shown promise as dwarfing rootstocks and hence could be tried for this purpose.

6.4.8. About 75 per cent of area and production of banana are in the peninsula and about 20 per cent in the eastern region (Orissa, West Bengal and north-eastern States). The yield varies from 8 tonnes/ha in Kerala to 18 tonnes/ha in Tamil Nadu and 20-25 tonnes/ha in Gujarat and Maharashtra. In Tamil Nadu, banana is raised in well-drained soils in rotation with paddy receiving high doses of manures and fertilisers. In Maharashtra and Gujarat, intensive cultivation of banana is backed by strong cooperatives, which supply inputs and arrange for marketing. In Kerala, the variety grown is susceptible to bunchy top disease and is a low yielder. The crop deserves full attention to meet not only the export demand but also the internal demand. Efforts should, therefore, be made to increase the area under banana considerably. The strategy should be to make its cultivation widespread, preference being given to small scale production.

6.4.9. The research base for the crop is good. The Indian Horticultural Research Institute (IHRI) has taken up a comprehensive research work for banana improvement, under which special attention is being given to exportable varieties. Packages of practices from preparatory tillage to harvesting have been developed for different regions and different situations like the plains and the hills. It is necessary to bring about further improvement in cooperation with the agricultural universities of the regions concerned. Efforts should be made to improve the yield and quality of banana over the entire area. The problems which need attention in future are spacing of plants for healthy development, introduction of ratooning, beneficial combinations and techniques of mixed cropping, combating pests and diseases like those of 'bunchy top', leaf spot and nematodes, means and methods of reducing water requirement, harvest techniques and ways of protecting banana bunches from external injuries, insect bites, sunburn etc. Pending the outcome of spacing trials, a 2m x 2m distance between plants should be advocated as an interim measure, till measures are developed to combat bunchy top disease. Where it has assumed very serious proportions (e.g. Kerala), a complete replanting with disease-free suckers is necessary. In those areas, where the disease is not serious, a suitable package of practices for its elimination could be popularised.

6.4.10 About 40 per cent of the citrus area of 0.1 Mha is that of mandarins and about 25 per cent of sweet oranges and limes. The citrus groves and orchards are not receiving the attention they need to get high yields. Inadequate application of fertilisers, absence or over-doing of tillage causing root injury and infection and lack of irrigation are the limiting factors in citrus production. The citrus die-back disease, which is highly pronounced in India, and affects yields, has to be combated effectively to minimise production loss.

6.4.11 The incompatibility of seion and stock in citrus groves can be an important primary cause of crop failures. It is, therefore, necessary to find out through experiments compatible stocks for different varieties of citrus for different regions. Future research work should also include evolving of nucellar line plant material and hybridisation work with a view to evolving varieties resistant to root rot and viruses, saline conditions and nematodes. Studies are also needed to standardise cultural practices for commercial varieties and to develop suitable schedules of intercrops. The effect of various nutrients in different doses on commercial varieties raised on different rootstocks, the biochemical changes which occur in various infected or die-back affected plants, the virus-vector relationship and sterilising the vector by irradiation technique and the possibility of inducing resistance against severe strains of known viruses by cross protection with mild strains require study. There is also need for intensifying the programme for certification, inspection and registration of virus-free mother trees and propagating and multiplying such virus-free trees under foundation blocks for future sources of virus-free healthy bud-woods.

6.4.12 In order to resuscitate the existing citrus orchards, packages of practices for different agroclimatic regions have been evolved. It is desirable to draw up the programme for replantation of citrus orchards by encouraging interplanting of the existing orchards with better grafted plant/material with a view to ultimately cutting down the old trees.

6.4.13 Papaya is grown in many parts of the country in homesteads and gardens, and also as a regular crop. In Maharashtra and Gujarat, some pharmaceutical firms have tried tapping papain from papaya, but not on a commercial scale as yet. Papaya is one of the few fruit plants which is propagated by seed. Vegetative propagation does not seem possible in this case. Research work in other countries indicates that gynodioecism with complete elimination of males can be introduced in dioecious cultivars. Either this technique could be adopted or efforts made for breeding stable cultivars. The other desirable characters to be introduced are dwarfness, high yield of fruit as well as papain, and uniform shape, size, texture and flavour of fruit. Suitable control measures and breeding efforts are required for combating diseases like

damping off', collar rot mosaic, leaf curl and distortion ringspot. Development of frost resistant varieties is also necessary.

6.4.14 Guava is cultivated in many agroclimatic regions of the country and is fairly drought resistant. Uttar Pradesh, Bihar, Madhya Pradesh and Maharashtra account for 80 per cent of its area and production. It is desirable to encourage the cultivation of guava in as many congenial situations as possible. Experiments are needed to identify the best fruiting season in a year in every region of the country from the point of view of quality and quantity. Proper nutritional and irrigational standards have also to be established. Resistance to wilt disease will have to be introduced in new varieties. Unless resistance is proved pathogenetically, no cultivar should be taken as resistant, even when growing is unaffected for many years.

6.4.15 The seasonal supplies of apple, which begin in June, keep on coming to market till early November. Thereafter the fruit kept in cold storages is sold. The keeping quality of apple, therefore, assumes great importance. On scientific considerations, it is not advisable to rely on any one type of apple, subject as it is to the risk of failure on account of weather or disease outbreak. It is, therefore, necessary to broaden the genetic base of sweet varieties of apple by exploring the possibility of utilising wild germ plasm. In the south the consumer preference is for bright coloured and sour apples, the production of which is not sufficient at present to meet the demand. The area under such apples needs to be extended.

6.4.16 Apple cultivation to be successful below 1,500 metres, needs varieties which have a shorter dormancy period and are accustomed to milder temperatures. Similarly, experimental evidence suggests that apple cultivation can be taken up at elevations higher than 2,000 metres. Varieties are, therefore, required to be evolved for elevations lower than 1,500 metres and more than 2,000 metres. The economics of apple cultivation at higher elevations will have to be worked out.

6.4.17 The latest trend in the horticulturally advanced countries is to prefer dwarf varieties of apple. The plants grafted on dwarfing rootstocks are found to give high yields and better quality of fruits. Dwarf trees allow a higher density of plant population per unit area and the technique of horizontal training of branches is employed to prevent vertical development of the trees. It is observed that the bearing in this way takes place within two to three years of planting as against 10 years required for the usual trees. The technique has given encouraging results under experimental conditions in Himachal Pradesh, which is trying to advocate the new method for large scale adoption on trial basis. The relative economics of the new method as against established methods will have to be tried experimentally.

6.4.18 Fresh grapes are produced in the country around Coimbatore and Bangalore in the south during December-June, in Hyderabad-Poona-Nasik belt in Maharashtra and Khandesh region of the Deccan in February-April and in the Punjab-Haryana Regions and adjoining irrigated parts of Rajasthan during April-June. The main crop is, however, taken in the peninsula. In the northern parts, grapes will have to compete with other irrigated crops like cotton and sugarbeet during the summer months. It is, therefore, necessary to study the comparative economics of grape cultivation *vis-a-vis* other field crops grown in Punjab, Haryana and Rajasthan in order to encourage grape cultivation in the area.

6.4.19 Pipeapple is grown on a field scale in the west coast and the north eastern region. The areas reclaimed from shifting cultivation in the north eastern region offer good scope for raising pineapple. At present the yield of pineapple is very low at 10-12 tonnes/ha as against 60-70 tonnes/ha in Hawaii. Although research on pineapple is being undertaken at the IHRI, Bangalore and the Banana and Pipeapple Research Station at Trichur, it is necessary to organise research on regional basis in the pineapple growing areas of Assam, Maharashtra, West Bengal and Orissa. Suitable agronomic and plant protection schedules for different areas need to be developed and recommended. Methods for activating slip production by using vegetative bud dormancy breakers and reducing the unproductive off type population require to be worked out. A long range breeding programme needs to be taken up in order to get better varieties than the available ones for canning as well as for table purposes.

6.4.20 Walnut is grown in the Kashmir valley and in the hills of Himachal Pradesh and Uttar Pradesh. Walnut needs special attention because of the potential it has to earn foreign exchange. Majority of the existing walnut trees are of seedling origin bearing fruits of mixed types. Non availability of grafted plants of good varieties is the main bottleneck in expanding the area under quality walnut trees. The grafts start yields from the fourth year onwards whereas the seedling trees yield after 8 or 10 years. Steps will have to be taken to make available walnut grafts to replace the seedling trees. Appropriate production techniques have to be adopted and proper care taken of the plantations so that while a doubling of the existing area of 6,000 ha is attempted by 2000 AD, production could be increased 2½—3 times the present level.

6.4.21 Some of the research problems common to all fruit crops are :

- (i) Considerable variation in respect of yield and quality even in the same cultivar is a problem commonly occurring in a

number of fruit crops. It is essential that clonal selection is made to choose the best cultivars in all fruit crops, wherever feasible, in order to ensure a consistent standard of yield and quality.

- (ii) Tillage and irrigation which are neglected in most orchards need more attention. Better agronomic and plant protection practices need to be developed and popularised. Recent researches indicate that the nutritional status of leaves is a better index of mineral requirements of plants than the nutritional status of soil. To ensure, therefore, that adequate fertiliser doses are applied to horticultural plants, it is necessary to establish foliar analysis laboratories and organise an advisory service. This could be done by the agricultural universities.
- (iii) Not more than 1.25 Mha out of the proposed area of 4 Mha under fruit crops can have irrigation. Research is necessary to determine the crops which could be raised under rainfed conditions, under assured irrigation support or with dependence partly on rainfall and partly on irrigation.
- (iv) As the use of plant protection chemicals in orchards and groves is likely to increase in future, the problem of residual toxicity will also need attention.
- (v) The possibility of improving production through top-working exists in the case of a number of fruit crops. Studies are required to be carried out to standardise techniques of top-working for different crops for large scale adoption.
- (vi) It is necessary to establish model orchards in each district to determine the economics of production and to serve as centres of practical demonstration in better methods of cultivation.
- (vii) On the development side, establishment of progeny orchards and supply of genetically uniform nursery stock is of urgent necessity.

In undertaking all the above measures, the agricultural universities should play a leading role.

6.4.22 Fruits of all India character require an all India approach to their problems with coordination at the Central level, in addition to the regional research undertaken by the agricultural universities. An All India Coordinated Fruit Improvement Project has accordingly been in operation involving the IARI, IHRI and the Central Mango Research Station at Rahmankhera (Lucknow). For temperate fruits,

regional research is necessary. Two institutes of temperate fruits, one in the north western Himalayan hills and the other in the north eastern hills should be established for the purpose. Research and development in respect of crops of local importance should be the responsibility of the States and agricultural universities concerned.

Tuber Crops

6.4.23 The commonly known tubers are potato, sweet potato, tapioca, yam and arrowroot. Potato, sweet potato and tapioca are important from the all India point of view whereas the others are only of regional importance. Being rich in carbohydrate, potato, sweet potato and tapioca supplement cereals in varying degrees. Tapioca and seed potato and table potatoes have good export prospects. Industrial utilisation of some of the tuber crops like potato, sweet potato, tapioca, yam and arrowroot hold out possibilities of greatly increasing the production of these crops both for internal use as well as increased export.

6.4.24 Potato is grown in all parts of the country, the major producing areas being Uttar Pradesh, Bihar and West Bengal. Bulk of the seed potato is produced in Himachal Pradesh. The present area under potato is about 0.5 Mha. The yields vary from 9 to 12 tonnes/ha in Uttar Pradesh, Bihar and West Bengal and from 4 to 5 tonnes/ha in other States, the average all India yield being 9 tonnes/ha. The yield is, however, the highest in Gujarat at 25 tonnes/ha because of better crop management. The yield registered in State research farms as well as by the Central Potato Research Institute, Simla is around 30-35 tonnes/ha. On account of varying methods employed in reporting yield levels, there is an urgent necessity to extend the method of crop cutting surveys for the estimation of potato yield to all the important producing States including Uttar Pradesh.

6.4.25 Potato cultivation is both capital-intensive and labour-intensive requiring considerable investment in seed, fertilisers, plant protection, chemicals and irrigation. In the plains, the crop does not stand long storage in summer months requiring cold storage facilities before the produce can profitably be marketed. Even in the hills, the crop is subject to damage in storage. The yield per unit area is low because of ecological constraints in certain areas, non-availability of disease-free seed, high incidence of pests and diseases and inadequate use of inputs. Small farmers do not, therefore, venture to take this crop which remains confined to areas near about cities and towns and has so far not spread to the interior. It is only when cold storage and marketing facilities become widespread that the area under the crop could be extended to

interior villages. Potato is covered by a well-organised research and development setup. The Ministry of Agriculture and Irrigation has also put through a series of measures to increase the production of potato and promote its increased consumption. On the technical side, development of disease and pest forecasting techniques with special reference to late blight and aphids, integrated disease and pest control and problem of residual toxicity of pesticides, use of polyhaploidy and tissue and organo-culture techniques in developing new improved varieties require attention.

6.4.26 Though grown all over the country, sweet potato is concentrated mainly in Bihar, Uttar Pradesh and Orissa which account respectively for 34, 25 and 12 per cent of the all India area of 227,000 hectares. Yields vary from 5 to 8 tonnes/ha, with Uttar Pradesh recording an average of 10 tonnes/ha. It is a neglected crop with no good seed varieties, most of the available varieties being disease-ridden. Attempts are being made at the Central Tuber Crop Research Institute (CTCRI) at Trivandrum to develop varieties through selection and hybridisation with a view to achieving higher yields with high starch and sugar content. The main crop is generally taken rainfed during the kharif season, although the planting period varies widely from early March in north India to September in south India. Being a short duration crop it can fit into different crop rotations, which vary from place to place. Accordingly, research on these crops is best undertaken on a decentralised basis. But seed setting takes place best in tropical conditions of south India. Basic research, including work on breeding, should continue at the CTCRI, Trivandrum. Selection and multiplication subsequent to the basic work at CTCRI has to be done in different States. Research of local importance should be done in the various States so that agronomic and plant protection techniques are developed in accordance with their need.

6.4.27 Kerala account for 85 per cent of area and 90 per cent of production of tapioca in the country and Tamil Nadu 12 per cent of area and 9 per cent of production. Further increases in area are possible in Tamil Nadu, Karnataka, Andhra Pradesh, Assam and, to a certain extent, in Maharashtra and Orissa. All of them have suitable agroclimatic conditions for raising tapioca. Tamil Nadu has developed its industrial use, there being as many as 700 small scale units manufacturing sago in the State.

6.4.28 Kerala has developed varieties suitable for starch and sago which have an internal as well as an export market. Sponsored by the ICAR, the State has undertaken a hybridisation programme involving both indigenous and exotic stock and isolated a dozen hybrids recording higher yield than the local varieties. In Tamil Nadu, the State

Government has also established a research station at Salem mainly for adaptive trials on this crop.

6.4.29 There should be clearcut plan for developing separate varieties and techniques for culinary and industrial purposes in the case of tapioca. Some of the characters which have necessarily to be incorporated in the culinary varieties are stalked tubers, medium in size and with good drying ratio. Small sized plants, early maturity and mosaic resistance are some other characters which will be equally good for both the purposes. There is need to lay special emphasis on improving the keeping quality of tapioca through breeding. The CTCRI, Trivandrum should undertake basic work including breeding in collaboration with agricultural universities of the States concerned. Since breeding of mosaic resistance varieties is a long range programme, an interim plan of action for immediate adoption is necessary. As the per capita consumption of tubers is at a low level, it is necessary to have a vigorous extension drive, on the one hand, and research programme to develop various kinds of palatable recipes, on the other, through the home science colleges and the agricultural universities. The ICAR should provide guidelines and coordinate research work in this regard. The Ministry of Agriculture and Irrigation at the Centre and the State Departments of Agriculture should undertake a coordinated programme of publicity through press, audio-visual means and public contact to popularise the use of all tuber crops.

Bulb Crops

6.4.30 The peninsular States of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu, together with Orissa, constitute the main producing region accounting for 70 per cent of all India onion area. Maharashtra is the most important State recording yields of 15 tonnes/ha, the all India average being 10 tonnes/ha. Yields in Karnataka and Orissa are very low (5 tonnes/ha). However, as there is no reliable estimate of area and production, arrangements should be made to collect statistics of area and production of onion through sample surveys conducted at least once in five years.

6.4.31 Besides increasing internal demand, a good export demand for fresh onion is likely to develop. There is also high demand for onion in dehydrated form. Nonavailability of suitable varieties is likely to be a bottleneck. Varieties, which will give maximum outturn and yet possess other desirable qualities like colour, size, pungency etc., need to be developed. In the absence of any set onion variety of agro-nomic standards, the existing varieties need to be screened for isolating genetic bases. High yielding, disease-pest resistant varieties suitable for different kinds of uses have to be developed together with proper agro-

nomic and plant protection schedules. Botanical studies would have to be undertaken for finding out optimum condition of flowering, pollination and seed setting.

6.4.32 The research and development activities in regard to onion have not been regular and systematic. As the varieties and seasons of cultivation vary from place to place, each State must arrange to tackle its own the research and development problems of onion crop. It will be desirable, however, for the major producing States to set up an inter-State consultative machinery for mutual benefit.

6.4.33 *About 60 per cent of the total area of 25,000 ha under garlic is in the States of Madhya Pradesh, Gujarat, Maharashtra and Karnataka, more or less equally distributed, accounting for 70 per cent of the country's production. The yields vary from 2 tonnes/ha in Karnataka to 9 tonnes/ha in Gujarat, the average for all India being 4 tonnes/ha. It should be possible to raise the yield to 10 tonnes/ha through varietal and agronomic improvement. Since varietal differences explain the variations in yield, there is need for regional approach to crop development with each State tackling the research and development problems by itself.

Vegetables

6.4.34 The total area under vegetables in the country is estimated at 0.90 Mha. Besides cultivated vegetables, there are many wild plants whose leaves, floral buds, flowers or raw fruits are consumed in the country side on an appreciable scale during seasons of availability. It will be helpful to make an exhaustive catalogue of such vegetables through suitable surveys and encourage the growth of most useful ones in cooperation with the Forest Departments.

6.4.35 The nutritional needs require consumption of vegetables of 200 g per adult per day (160 g/day and 180 g/day respectively for diet based on rice and wheat). At 180 g/day, the quantity of vegetables need in 2000 AD by the adult equivalent of the population will be 50 million tonnes. At 200 g/day the requirement would be 55 million tonnes. Besides, the country has to make provision for export as well as for processing. Fresh vegetables have been exported to UK, Kuwait, Nepal, Bahrein, Quatar and Dubai, the average annual exports between 1969-70 and 1971-72 being of the order of 3,000 tonnes. Processed vegetables of about 6,000 tonnes are also in demand. Considering the potential for internal demand as well as for export, production could be planned for 80 million tonnes of vegetables in 2000 AD on an area of 4 Mha, assuming an average target yield of 20 tonnes/ha and with an expected 50 per cent of the area being under irrigation.

6.4.36 Suburban cultivation of vegetables represents the traditional pattern of vegetable culture (olericulture) in India. It is practised by a hereditary class of growers who dwell around towns and cities on very small holdings of a few cents of a hectare, which are almost permanently fixed for vegetable growing. The vegetable holdings are wholly irrigated with relay cropping being a dominant feature of cultivation. Continuous use of the same piece of land season after season makes it a harbouring ground for pathogens and pests, with effective plant protection measures lacking to combat the incidence of pests and diseases. The vegetable belts around cities and town require better and efficient methods of production. The effluent from the organised sewage system in most of the big towns and cities serves the purpose of irrigation, besides providing manurial ingredients in soluble form. Places like Delhi and Poona have special canal or pipe system to make available such effluent water for cultivation. This type of service has to be developed in every city and town and popularised. The sludge obtained from this system is substantial and could be a very effective source of soil enrichment.

6.4.37 Individual vegetable holdings, being very small, do not admit of modern mechanised methods of cultivation. Contiguous plots could be formed into suitable blocks for major collective operations like dusting, spraying, tractor ploughing etc. It should be the responsibility of State Departments of Agriculture/Horticulture to organise the growers into suitable cooperatives so that they can derive the benefits of such collective measures. It should also be the responsibility of the Government to see that proper facilities for various kinds of operations are placed at the disposal of the grower in the form of custom services, which should be organised either through cooperatives or through Governmental organisations. So far as irrigation is concerned, State Governments will have to ensure that the entire vegetable area is duly commanded by canals or wells, and that the growers are encouraged to sink wells on a joint ownership basis. All possible guidance and assistance should also be provided to them.

6.4.38 The varying agro-climatic conditions of the country permit the growing of every kind of vegetable and with the development of rail and road transport, it is possible to make available vegetables grown in high hills to the plains all through the year. Out of the proposed area of 4 Mha under vegetables, 0.2 Mha should be earmarked for development in the hills area, about 2.8 Mha for vegetable belts around towns and cities, 0.8 Mha along banks of lakes, rivers, canals and 0.2 Mha for kitchen gardens in the interior village, cities and towns. Vegetable cultivation should be undertaken simultaneously with increased input supplies and improved means of transport and communications. In extending the area under vegetable cultiva-

tion the towns and cities should get the first preference and then the hills, tank beds, lakes, rivers and canals and interior villages in that order of priority.

6.4.39 Most of the vegetables have no standard varieties. There is a lack of knowledge and practice of scientific vegetable cultivation among growers in respect of time of planting, optimum plant population per hectare, composition and dosage of manures and fertilisers, irrigation, utilisation of pesticides, insecticides and hormones. In view of the diversities relating to soils, climate, orography, irrigation facilities, etc., vegetable research has to be organised on a regional basis with agricultural universities having to play an important role. An All India Coordinated Vegetable Improvement Project has been started with a coordinating cell at the IARI. In terms of organisation and extension, vegetable development is now a part of the general crop development programmes with no specific attention being given to vegetable crops as such. This might largely get corrected when horticultural field staff are made available at the block and circle levels in due course. Meanwhile, crop rotations and companion cropping beneficial from the soil point of view, could be introduced in vegetable cultivation, and in this respect, short statured beans or fodder legumes like berseem and lucerne could prove useful. The production programmes will have to be oriented to the needs of processing industries as well as to promote exports. Breeding programmes should take into consideration the requirements of processing and export and the consumer preference in foreign countries with regard to colour, shape, size and taste. Hybrid vigour should be increasingly utilised for providing high yielding varieties of quality suited to various purposes and tastes. It will also be good to introduce disease resistance in F1 combination of hybrids when resistance is found to be governed by dominant genes. The basic handicap in the past was the absence of a scientifically organised vegetable seed industry. Hybridisation work has since been undertaken at the IARI, IHRI, the Punjab Agricultural University, the Vivekananda Laboratory at Almora and the Institute of Agricultural Sciences, Kanpur and work is in progress in respect of onion, bottlegourd, chillies, tomato, brinjal and cabbage. The hybrids released so far are, however, very few.

6.4.40 There are a large number indigenous vegetables, particularly leafy ones, on which no systematic studies regarding nutritive values and agrotechniques have been done. Leafy vegetables belonging to different species should be collected and evaluated for their nutritional and other desirable characters.

Condiments and Spices

6.4.41 Kerala accounts for 45 per cent of all India area of 9,000 ha and 54 per cent of production of ginger. Next comes the north eastern States which account for 16 per cent of area and production. Both Kerala and Assam have congenial climate for ginger cultivation and can grow varieties of ginger which are less fibrous than those grown in other parts. Kerala has specialised in producing dried ginger and is the only State which exports ginger to other countries. Indian ginger is high-priced and has higher fibre content because of which the export demand is less when compared with the Jamaican and Siera Leone gingers. It is, therefore, necessary to evolve high yielding fibreless varieties of ginger which are in demand in foreign markets.

6.4.42 Research should be focussed on Kerala which is a leading producer of ginger. All the States producing ginger should collaborate in research and development programmes. Steps should be taken to enable the north eastern region to make its contribution towards meeting the internal as well as the external demand for ginger. Given the necessary research support, the yield could be nearly doubled to 2.5 tonnes/ha. For successful commercial exploitation, ginger research stations will have to determine the optimum stages of maturity necessary for different purposes like the manufacture of ginger preserved in syrup, candy, oleoresin and essential oil etc.

6.4.43 Andhra Pradesh and Tamil Nadu together account for 60 per cent of all India production to turmeric. The other important producing States are Bihar, Orissa and Maharashtra. The yield is low (3.8 tonnes/ha in Tamil Nadu is the highest). Primary research work on the crop should be jointly undertaken by the States of Bihar, Orissa, Maharashtra, Andhra Pradesh and Tamil Nadu to help increase the yield to a maximum of 5 tonnes/ha and an average of 3.5 tonnes/ha by 2000 AD.

6.4.44 Almost all the States raise the chillies crop but the important producing States are Andhra Pradesh, Maharashtra, Tamil Nadu and Karnataka. The yield ranges from 3 to 6 q/ha with Tamil Nadu recording the best yield of 14 q/ha. The crop is susceptible to high incidence of disease like mosaic, leaf curl, die-back, wilt and fruit rot. If varieties resistant to disease could be evolved and suitable agronomic and plant protection schedules are developed, the yield can be doubled. Research for the purpose should be undertaken by the States concerned.

6.4.45 Rajasthan, Maharashtra, Andhra Pradesh, Madhya Pradesh and Tamil Nadu are the major coriander producing States. The

average all India yield is about 4 q/ha. The crop is susceptible to wilt and downy mildew. The States concerned should give due attention to research and development problems so as to step up production to twice the present level of 11,000 tonnes.

Mushrooms

6.4.46 Mushrooms either grow wild or the artificially cultured. *Morchella* is the only major species among wild types which has received attention in this country so far. It is grown in the coniferous forests of the high hills at elevations between 2,500 and 5,000 metres, and is commonly used in the States of Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh. It is abundant in the years of heavy snow fall in freshly cleared forests rich in organic matter. Its maximum exploitation is in Jammu & Kashmir followed by Himachal Pradesh. In the Uttar Pradesh hills mushroom is not collected to any large extent. It is sundried and preserved for consumption, and for sale. Annually about 28 tonnes of dried *morchella* in Jammu & Kashmir and 9 tonnes in Himachal Pradesh are obtained, of which 80 per cent is exported.

6.4.47 Among cultivated types, *Agaricus Bisporus* (temperate mushroom), which is grown on compost in specially constructed mushroom houses, is the only cultivated mushroom being commercially exploited in the country. During the last few years, its cultivation has been developed in the Kashmir valley, Himachal Pradesh, Uttar Pradesh and the Nilgiri Hills of Tamil Nadu. The import of canned *agaricus*, should be replaced by indigenously canned mushroom now being made available.

6.4.48 Organised production of mushrooms has received attention in Jammu & Kashmir and Himachal Pradesh by a fullfledged Department of Mushroom Development in the former and the Department of Agriculture in the latter. There is a Mushroom Research Institute and Spawn Laboratory at Solan (Himachal Pradesh), which is the main centre for the supply of spawn and for training in mushroom cultivation. While preservation of mushroom by canning is gradually increasing, scientific drying of mushroom is not developed to any extent. The artificial cultivation of mushroom should be organised near such cities where it is possible to provide dehydrating and canning facilities. Mushroom cultivation should be confined to persons who have the requisite knowledge of mycology and are trained in the art of cultivation. Proper spawn laboratories will have to be established under Government control to avoid chances of contamination and to ensure quality. Import of spawns has to be banned, except

when required for experimental purposes, and then also under rigid quarantine regulations.

6.4.49 The States desirous of undertaking collection of wild mushrooms or participating in the artificial cultivation of mushrooms will have to create necessary setup. The involvement of State Forest Departments will also be necessary for the wild mushroom and that of the Department of Agriculture/Horticulture for the cultivated one. Agricultural universities of the concerned States, the Mushroom Research Institute, Solan, the Hill Fruit Research Station, Chaubattia (Uttar Pradesh), the IARI (Mycology and Plant Pathology Division) and the IHRI should be responsible for mushroom research. The ecological conditions conducive to abundant production of wild mushrooms need study. The Hill Fruit Research Station, Chaubattia should undertake necessary research for popularising the production of truffles throughout the sub-Himalayan oak belt. The Mushroom Research Institute, Solan, the IARI and the IHRI should provide necessary data and advice to the Agricultural Marketing Adviser to the Government of India and the Indian Standards Institution to enable them to lay down quality standards for dried mushrooms so that grading is made possible as a compulsory measure in due course.

Floriculture

6.4.50 Flowers, like vegetables, are intensively cultivated in small plots of land mainly around the towns and cities in the country. There is substantial trade in cut flowers estimated at Rs 9.26 crores annually. A facet of floriculture in India is the maintenance of ornamental hedges and lawns by individuals and institutions including public parks and gardens. Agro-horticulture societies have existed in metropolitan cities and are extending to other cities and towns. The benefit of research and modern techniques has been mostly confined to this aspect of floriculture.

6.4.51 A good research base is gradually being built up for ornamental plants. The need is, however, to explore various avenues by which floriculture can be expanded and made more lucrative, particularly by exploring the export potential for cut flowers and bulbs. A selective approach is necessary in capturing the foreign markets. The best period, which can be exploited to India's advantage, is winter when temperate and cold countries have the natural handicap of not being in a position to grow plants ordinarily. As far as bulbs are concerned, the country should specialise in such tropical material which is not commonly grown in other countries.

6.4.52 For the promotion of exports of various kinds of cut flowers, it is desirable to develop special floriculture blocks in the neighbourhood of airports. This activity could preferably be entrusted to agricultural graduates. Dry flowers also offer a very good export market and this technique has, therefore, to be increasingly utilised. Orchids are more suitable for export than the cut flowers because of better price, lighter weight, easy packing and longer life. Large scale propagation of outstanding hybrids of several orchids is being done by meristem culture in other countries, but no such attempt on major scale has been made in India. Production of new and attractive hybrids of orchids under controlled conditions requires attention. In addition, there is need to protect and proliferate the natural orchid flora of the country. It is necessary to create orchid sanctuaries in the natural habitats of these plants and regulate their exploitation.

6.4.53 Landscape planning with the help of attractive flowering and nectar bearing plants on a countrywide scale will increase the scope of floriculture in the country. It is necessary to constitute a Central Committee for landscaping to prepare alternative landscape plans to fit into the programmes of development of villages, towns and cities. The State Governments should actively collaborate with the Central Committee in the preparation and execution of the master plans, which should also include in their scope the national highways, canals, railways and riversides.

6.4.54 The national flower of India, i.e. lotus, should receive special attention in research and developmental activities. The ICAR should encourage research on ornamental as well as edible aspects of this flower. A survey also needs to be undertaken to determine the scope for the cultivation of the various species of lotus family which have economic value. The State Governments concerned have to evince deeper interest in organising its production in a systematic manner.

Aromatic and Medicinal Plants

6.4.55 There are a number of essential oil bearing plants of pure medicinal value or pure aromatic value or both. The important plants are sandal, lemongrass, palmrosa, eucalyptus and *keora*. The use of herbal medicines is considerable in India, the annual export of crude herbal drugs being to the tune of Rs 3.3 crores during the five years ending 1971-72. A systematic approach to the development of medicinal plants in the country was made in 1959 when the Central Indian Medicinal Plant Organisation (CIMPO) was set up at Lucknow by the

CSIR. A number of other organisations have also been working in the field of medicinal plants for a number of years. But, barring specialised efforts of the FRI, Dehradun, the Central Council of Research on Indian Medicine and Homeopathy and the Governments of the Tamil Nadu and West Bengal, research on medicinal and aromatic plants by a multiplicity of organisations is not desirable. Research on production of all kinds of medicinal and aromatic plants and introduction of new species should be brought under the ICAR. Research on processing and utilisation should be the responsibility of the CIMPO, the work being suitably coordinated with the ICAR.

6.4.56 Insofar as herbal medicines are concerned, the Botanical Survey of India, Calcutta and the National Botanical Gardens, Lucknow in consultation with Central Council of Research in Indian Medicine and Homeopathy should list all the concerned plants and prepare illustrated descriptions in popular languages giving the names, the part of the plants used, medicinal importance and the methods employed for their use in various common ailments. In regard to the category of plants, whose medicinal values and use are well known but whose identification is uncertain, the CIMPO should standardise procedures to certify (a) the correct identification of plants, (b) the part of the plants used and (c) their expiry periods. They may constitute a committee for this purpose with representatives from National Botanic Gardens, Lucknow, Central Council of Research in Indian Medicine and Homeopathy, Indian Council of Agricultural Research, Botanical Survey of India, Forest Research Institute, Central Drug Research Institute and Indian Council of Medical Research.

5 PLANTATION CROPS

6.5.1 Tea, coffee, cardamom, pepper, rubber, cashewnut, coconut, cacao and arecanut are the more important among a large number of plantation crops that are grown in the country. There are possibilities of taking up the cultivation of oil palm, clove and nutmeg in future. Tea, coffee, cardamom and pepper have been considered in the Commission's Interim Report on Certain Aspects of Selected Export Oriented Agricultural Commodities and recommendations given for their future development.

Rubber

6.5.2 India imports natural and synthetic rubber since the internal production is insufficient to meet the demand. The Rubber Board has

estimated the total demand for rubber at 1.5 million tonnes in 2000 AD. Considering the recent trends in the consumption of natural and synthetic rubber in India and other countries, it may be expected that in future the proportion between natural and synthetic rubber will be in the ratio of 50 : 50. On this basis the requirement will be 750,000 tonnes of natural rubber and an equal quantity of synthetic rubber in 2000 AD. All research and development activities relating to natural rubber in the country are controlled and regulated by the Rubber Board.

6.5.3 The Rubber Research Institute at Kottayam (Kerala), established by the Rubber Board, has evolved high yielding clones and also effected improvements in budding techniques and in the balanced application of fertilisers. There is further need to breed varieties of rubber resistant to abnormal leaf-fall and the powdery mildew disease. It is also necessary to breed special varieties for the proposed new areas in the States of Maharashtra, Andhra Pradesh and Orissa, which represent comparatively less humid conditions than Kerala and Assam.

6.5.4. Kerala accounts for 93-94 per cent of the country's area and production of rubber, Tamil Nadu and Karnataka being the other States where rubber is grown. The yields vary from 3 to 4 q/ha in Kerala, 4-5 q/ha in Tamil Nadu and 1.5 q/ha in Karnataka. Among all plantations, the small holdings (up to 20 hectares) preponderate, their contribution to total production going up from 27 per cent in 1960-61 to 54 per cent in 1969-70. The small holdings, particularly those below 4 hectares, have not been able to benefit from improved cultural practices evolved and other development facilities like replanting subsidy and new planting loan schemes. The Rubber Board's schemes of assistance to rubber plantation should be modified so as to benefit the small growers. The handicaps of the small holders should be overcome by organising them into effective cooperatives. There is also need for creating farmers' service societies or other co-operative service organisations supported by the State to do custom services for pest and disease control, and also in the processing of latex. In the existing private rubber plantations, the technical competence in management can be gradually improved by encouraging the dependents of growers to go in for agricultural education. It is also worth examining whether agricultural graduates could be given preference in new areas meant for rubber plantations. With these measures, it should be possible to increase the yield level to 2 tonnes/ha in 2000 AD. At this projected yield level, an additional area of 175,000 ha will have to be brought under rubber, out of which 100,000 ha may be earmarked for the north-eastern region and the remaining 75,000 ha for congenial locations in the Western Ghats and Andhra Pradesh and Orissa.

Cashewnut

6.5.5 India's production of raw cashewnut is about 20 per cent of world's production, but its share in the world's total exports of cashew kernel ranged from 75 to 91 per cent during 1965-69. India imports nearly as much of raw nuts from African countries as its own production, for processing, and exports as much as 75 per cent of the processed quantity. This dependence on other countries for raw nuts cannot be allowed to continue in future. The country has to plan to produce its entire requirement of raw nuts by itself. The crop yield has to improve and the cost of processing brought down by increased mechanisation.

6.5.6 The ICAR has been making efforts to promote research on cashewnut, the responsibility for which is entrusted to the Central Plantation Crops Research Institute (CPCRI) at Kasargod (Kerala). The ICAR has also initiated a Coordinated Development Project for Spices and Cashewnut with a coordinating cell and a regional research station at Kasargod. A number of indigenous and exotic selections of promising types have been assembled at CPCRI. It is necessary that the existing high yielding varieties are first experimentally tried for their suitability to different agroclimatic conditions before being recommended for adoption. Although work on hybridisation is in progress, for genetic improvement the handicaps of a very small number of hermaphrodite flowers, low pollination and defective fertilisation will have to be removed. Research should give priority to this aspect. Cashewnut is mainly propagated through seed but vegetative propagation through airlayering is considered superior. Since airlayering has certain handicaps, an alternative method of improvement is through the technique of *in situ* grafting which has been tried on a large scale under the five year plans. If the results are successful, the method could be adopted for interplanting in cashew plantations so that the unproductive trees could be removed eventually. It is also necessary that a package of practices, including plant protection, is evolved for different regions for adoption by growers.

6.5.7 Kerala, Karnataka and Tamil Nadu account for 75 per cent of area and 80 per cent of production of cashewnut. Maharashtra, Andhra Pradesh, Orissa and Goa are the other States where cashewnut is grown. The yields in the States, other than Kerala, are very low. Cashew plantations in private lands are looked after by the Department of Agriculture/Horticulture whereas cashew trees in forests are the responsibility of the Forest Departments. It is necessary to prepare common guidelines and coordinate activities pertaining to cashew improvement programmes between the Departments of Agriculture/Horticulture and Forest. The former should ensure that

plantations plant the best material and are scientifically managed whereas the Forest Department should bestow upon this crop the same attention as is required for any plantation crop under their charge. In addition, the existing trees—whether in the forests or in private lands—could be improved through top-working and their yield increased. It is also possible to increase the area under cashewnut in the peninsular States and Orissa. Further the plantations from the existing unproductive sites should also be shifted to highly promising ones, both in private as well as in forest lands. Insofar as private lands are concerned certain incentives like the replanting subsidies, as in the case of rubber, could be given for this crop as well.

6.5.8 The cashew industry can get a big boost provided the cashew byproducts are fully utilised. It is necessary that the cashew apple, the cashew shell liquid and tannin from cashew testa are industrially exploited to open new avenues for development. The recommendations of the Spices Enquiry Committee regarding the indigenous utilisation of CNSL and the Cashew Enquiry Committee regarding the manufacture of tannin from cashew testa and utilisation of cashew apple should be considered and implemented in full.

Arecanut

6.5.9 The production of arecanut is largely confined to the Indian subcontinent. The area and production of arecanut were, with narrow fluctuations, around an average of 113,000 ha and 95,000 tonnes respectively between 1958-59 and 1964-65, but have since increased to 174,000 ha and 151,000 tonnes in 1971-72, the increase in production being mainly due to increase in area. The yield which was low at 8.4 q/ha during 1958-59 to 1964-65 had only marginally increased, the maximum attained being 9.2 q/ha in 1967-68. Kerala, Karnataka and the north eastern States account for 93 per cent of area and 94 per cent of production. The yield varies from 6 to 12 q/ha in the country.

6.5.10 The ICAR has sponsored organised research on arecanut through specific schemes and set up an all India coordinated project on arecanut research with the main station at CPCRI, which has a regional research station in Karnataka and substations in Kerala, Maharashtra, West Bengal, Assam and Andaman & Nicobar Islands. The development work is being attended to by the Directorate of Arecanut and Spices Development. As a result of research work, a few exotic varieties of arecanut have been identified but development of high yielding varieties with necessary package of practices needs attention. In this, the CPCRI should seek the cooperation of the State

agricultural universities. The CPCRI should get the knowhow from Sri Lanka, which has recorded high yields of arecanut (30 q/ha), in order to improve the standard of production in the country.

Coconut

6.5.11 About 95 per cent of coconut fruits is consumed as tender nuts and copra, the rest being used for oil extraction. Kerala accounts for about 67 per cent, Tamil Nadu 16 per cent, Karnataka 11 per cent and Andhra Pradesh 3 per cent of the All India production of 6,000 million nuts. Its yield varies from 3,000 to 10,000 nuts per ha, Tamil Nadu recording 9,000 nuts/ha and Kerala about 6,000 nuts/ha.

6.5.12 The ICAR, through the CPCRI and the two Central coconut research stations and other substations, has organised research on coconut and set up a Coordinated Project for Arecanut and Coconut Development for the purpose. One of the important research results obtained relate to the breeding of hybrids between tall and dwarf varieties. The natural cross dwarf hybrids, being tolerant to root wilt, are capable of yielding twice as much as the normal varieties, with higher copra content per nut. The use of sea water for irrigation of coconut farms is found to improve productivity without any evidence of bad effect in light soils. This finding should be put to use in light soils in coastal areas during summer season to irrigate coconut plantations.

6.5.13 Only about 10 per cent of the total area under coconut is at present covered by improved practices and efforts to produce and distribute hybrids have not made much headway. The available data indicate a declining trend in coconut yield chiefly because of the existence of degenerated plantations which are pest and disease ridden. A systematic plan of underplanting the existing plantations with the new hybrids/varieties has to be implemented with speed so that uneconomic trees could be cut off in course of time. Wherever it is felt that the existing plantations have to be shifted to new sites, this might also be done. A system of replanting subsidy could be introduced for this crop, just as in the case of rubber plantations. A vigorous extension programme is also required in order to educate the growers in the use of better cultural and plant protection techniques. The importance of attending to individual trees has to be properly emphasised. Besides replantation subsidy, the State Governments should provide quality seedlings, fertilisers and plant protection chemicals including the supply of chemicals in small packets to individual household growers. With these measures, the existing area of 1.05 Mha should give a production of 12,000 million nuts at an average yield of 11,400 nuts/ha in 2000 AD.

Oil Palm

6.5.14 The cultivation of oil palm initially introduced in the fifties, has not extended to any significant extent. About 32,000 tonnes of this oil were imported in 1972-73 at a cost of Rs. 5.7 crores. There is need to do away with this import as far as possible.

6.5.15 Hybrid seeds from certain crosses were imported from Nigeria in 1964 and planted in Kerala. These are considered promising with regard to germination, growth and number of branches of female flowers. Oil palm thrives best between latitude 16°N and 12°S in the region of high rainfall (200 cm annually) and high humidity. A programme for raising 2,000 ha plantation of oil palm in Kerala, which was initiated in 1969-70, is expected to be completed in 1975-76. Another project for raising 24,000 ha plantation is contemplated in the Andaman & Nicobar Islands. Because of the quality of oil and its various uses, the oil palm tree could be helpful in supplementing the vegetable oil resources of the country. The ICAR should arrange to conduct feasibility trials of oil palm in areas which are thought to be congenial. Side by side, it would also be worthwhile to find out experimentally the manner in which the tree could be grown successfully within the limitations of the agroclimatic conditions prevailing in the country. The seed of oil palm for planting has to be multiplied within the country itself in order to avoid reliance on import. Another important constraint which is to be removed to make this crop popular pertains to oil extraction. The fruits of oil palm cannot stand long distance transport or long time storage and consequently the pulp has to be deoiled almost immediately after harvest. It is desirable that the extraction plants are located close to plantations in order to avoid deterioration of the kernels during transport or storage. Arrangements should also be made to organise quick collection of fruits from small individual growers.

Clove and Nutmeg

6.5.16 Clove and nutmeg are the best known among the tree species. The country depends on imports for its requirements of these two species. The clove tree is concentrated in the Nilgiris and hills of Travancore (Kerala). It needs rainfall of about 150 cm well distributed over the year and is not likely to grow in any part of India with either a long hot dry season or a very low temperature. According to a survey by the ICAR, hill regions in the south west India at elevations ranging from 300 to 900 metres in Kerala, Tamil Nadu and Karnataka are more favourable for clove growing than the lower elevations of the coastal belt. It is necessary to locate suitable areas

in these parts and extend cultivation of the clove trees so that imports can be done away with in due course. Clove plantation could be pure or mixed, the tree being interplanted in the existing coconut and arecanut plantations and fruit orchards or as shade trees, windbreaks and avenue trees on roads.

6.5.17 Clove trees at present give highly variable yields. The problems of sterility and irregular annual fruiting have, therefore, to be studied. Absence of suitable methods of vegetative propagation and the limited range of genetic variability are the other difficulties in improving the crop. The death rate of seedlings being very high at present, a method of increasing germination of clove seed as well as for establishing plants without incurring serious loss through death needs to be evolved. Techniques in respect of training and pruning trees to induce formation of low broad bushy crowns, which can be easily reached for picking, manuring and irrigation, have also to be developed. In addition manuring and irrigation requirements have to be determined.

6.5.18 Nutmeg is cultivated in south India, though to a very limited extent, the climatic and soil requirements being similar to that of clove. Its cultivation, confined to only about 12 hectares now, should be extended along with clove to do away with imports. The main difficulty lies in the dioecious nature of the plant. The problem of identification of sex of seedlings before planting needs attention. Conversion of male plant into females by suitable techniques is another line for research which could prove useful in establishing fruit bearing plantations early and at a cheaper cost. Research on vegetative propagation also needs to be pursued.

Cacao (cocoa)

6.5.19 The area under cacao (cocoa) is confined to the southern-most parts of Karnataka, Tamil Nadu and Kerala. The CPCRI is concentrating on breeding and selecting varieties suitable to Indian conditions. Messrs Cadbury-Fry (India) have also undertaken to promote cacao production in the country by importing seed and providing seedlings for distribution as well as organising extension work.

6.5.20 The area under cacao at present is 1,200 ha. The production of beans is negligible, most of the plantings which are three years old being in the prebearing stage. Cacao growing could be encouraged as a part of mixed plantations and when this is achieved, a common service for plant protection operations and processing of beans may be organised to assist the small growers.

6.5.21 The first initial requirement is, however, to produce seed. It is advisable to select 150 ha for seed nurseries in the best possible

locations out of the existing cacao plantations and organise the seed production programme in the concerned States with the cooperation of the CPCRI. The seed material, so produced, should be made available to meet the needs of Andaman & Nicobar Islands. Besides, propagation through seed, the possibility of clonal propagation should be experimented with.

6.5.22 When the availability of cacao seed is ensured, seedling nurseries should be established in all producing areas of the country. Planning for the nurseries and the actual plantation areas should start right from now. The Ministry of Agriculture and Irrigation and the ICAR should render all help to the concerned States in this work.

6 FODDER CROPS

6.6.1 The vast majority of cattle and buffaloes in India are maintained on the agricultural byproducts consisting of roughages of low nutritive value. While the growth of animal population is almost unrestricted, the available feed resources for these animals have not kept pace with the increase in their number. The country has embarked on a massive crossbreeding programme to enhance production of milk and other livestock products. Increasing attention is also being given for improved animal health cover but feeding and nutrition requirements of the animals have been grossly neglected in the past and even now feed and fodder development programmes are receiving comparatively little attention. The available feed resources, being limited, must be distributed appropriately and in such a manner that these are put to best use for increasing production of milk, meat, wool, eggs etc.

6.6.2 Green fodder production is the most important single factor on which will depend the success of the animal husbandry programmes. By 2000 AD, the total requirement of green fodder will be of the order of 595 million tonnes besides that obtained from grazing. The area under fodder crops will, therefore, have to be increased from the present 6.91 Mha to 16.5 Mha in order to support and build up the country's animal industry. In order to cover the area required for fodder production, there should be a strong research base for undertaking an effective programme for the evolution of high yielding, nutritionally superior and disease-resistant varieties and the standardisation of package of practices as are applicable to different agroclimatic regions. There should also be massive farmer-oriented extension programmes on fodder crops, both for production as well as conservation, and efficient arrangements for the production, from breeder to the certified seed stage, distribution and timely supply of seeds of high yielding varieties to the farmers.

6.6.3 A research base has been created to tackle the problems of fodder and grassland development. But considering the vastness of the country and its agroclimatic diversities, the research work done so far is not sufficient to answer most of the pressing and unsolved questions, particularly in respect of the unirrigated areas and those with low and erratic rainfall. Furthermore, whatever improved technology has resulted from the research work already done, it has not percolated to the farmers' level. Little or no efforts have been made towards improvement or protection of the extensive grasslands available in the country. Due to decades of misuse and overgrazing, these grasslands have deteriorated, so much so that in many places the protective grass cover has almost been removed subjecting them to extensive erosion.

6.6.4 The present financial allocations in the State sector for the development of feeds and fodder resources are extremely meagre in relation to the need. The States have neither the basic infrastructure for undertaking effective development programme nor proper arrangements for production and distribution of seeds of fodder crops. To achieve the desired impact, radical changes will have to be brought about in the entire setup as well as working arrangements insofar as fodder development is concerned.

Cultivated Fodders

6.6.5 India has a very rich grass flora, which when properly exploited, can go a long way in meeting the needs of different regions. Among the green cereal fodders, jowar, bajra, maize and oats are of high quality. Among legumes, berseem and lucerne may be regarded as the most productive and popular rabi fodders. A good fodder should be palatable, digestible and devoid of any harmful components. It should be high yielding, quick growing and have a quick regeneration capacity where such a characteristic is desirable. Above all, the fodder should have high nutritive value.

6.6.6 Research should be directed to breeding high quality fodder varieties, if necessary by using germplasm available outside the country. Varieties so far evolved have mainly been selected on the basis of their fodder attributes, irrespective of their seed production qualities. Consequently most of the existing high yielding fodder varieties are shy seeders. Efforts should be made to incorporate high yielding character in them, combining high nutritive quality with high yield.

6.6.7 There is need to develop fodder varieties suitable to rainfed conditions and for low rainfall areas. Immediate attention should be paid to evolve grasses and legumes suitable for rainfed conditions. Dual purpose and multicut legume fodder varieties, which can overlap fodder scarcity periods of May-June and October-November, should

be evolved for inclusion in crop rotations. Very little work has been done in the country so far on the introduction of production of root crops like swede, turnip, mangold, beet and carrot for fodder. Some of these root crops produce high tonnage within a short period and can be fitted in the existing crop rotations. Arrangements for the production of such root crops should be made in the hills of northern India.

6.6.8 In view of diverse agroclimatic conditions and varied requirement of different regions, it is imperative to acquire and build up extensive collection of germplasm of suitable grass and legume species. Uptill now, no suitable legume has been identified for grasslands, particularly in the drier regions. Efforts should be made to locate the high yielding, quick growing and shade tolerant legumes which can combine well with cultivated fodders. In order to build up the required germplasm collection, experts should be sent to tropical/sub-tropical countries to locate promising grasses and legumes.

6.6.9 Few fodder crops have good keeping quality except when special techniques of preservation are employed. From the nutritional point of view, the fodder should be harvested when their quality and quantity are optimally matched. The optimum sowing and harvesting schedules should be determined for each fodder crop for each region. The use of fertilisers and nutrient elements for forage crops is as essential as for other crops. Possibilities of growing fodder crops, particularly legumes, in rotation with food and cash crops have not been explored. Intensive studies on the economics of fodder crops grown as a mixed crop or as a single crop should be carried out, both under rainfed as well as irrigated conditions.

Grasslands

6.6.10 Grasslands in India are at present in a deteriorated state due to decades of overgrazing and neglect. The grasslands normally carry many times the number of animals than they are capable of. It is necessary to limit the stocking rate of grasslands and to undertake measures for improvement of their productivity by controlled grazing.

6.6.11 A rational and scientific approach to the problem of grassland development needs a knowledge of the fundamental makeup of grassland of each agroclimatic region combined with appropriate measures for weed control and soil and water conservation and ecological management of grasslands. In hilly areas, grasslands and grazing lands have to be developed in a manner consistent with the requirements of watershed protection. In arid and semiarid regions, conservation of rainwater by gully plugging, putting small dams,

removing shrubs etc. should be practised. Ecologically, the system of management of grasslands should favour regeneration and multiplication of the most desirable species and maintain the grassland under optimum conditions of productivity. Where the extent of degradation almost resulted in the elimination of the desirable species, ecological succession could be assisted by the reseeding of such species under proper conditions of protection and management. But, since more information is required on this aspect under different systems of management, work on ecological improvement of grasslands, both with or without reseeding under different conditions classes, should be undertaken by the Indian Grassland and Fodder Research Institute (IGFRI), Central Arid Zone Research Institute (CAZRI) and agricultural universities.

6.6.12 Since grassland development work has been greatly handicapped by lack of seeds, research organisations should undertake a seed production programme for grassland development. It is also necessary to introduce a suitable legume component in the grasslands in order to improve the quality of the herbage and also to progressively improve soil fertility. As grasses and natural grasslands respond favourably to the application of fertilisers, intensive studies should be undertaken to ascertain the optimal mode of utilisation of fertilisers under different agroclimatic conditions.

6.6.13 For proper utilisation of grasslands, various systems of grazing can be used depending on available grazing and number of animals. The States in which grassland development programme should receive immediate attention, in addition to the arid and semi-arid areas of Rajasthan, Gujarat and Haryana, are Madhya Pradesh Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Bihar, Orissa and subtropical as well as temperate and alpine region of Jammu & Kashmir, Uttar Pradesh, West Bengal and Arunachal Pradesh.

6.6.14 There has to be a systematic survey of wasteland and village common lands in the different States for preparing a land use plan based on a village or a group of villages as a unit, and earmarking areas for grazing and for raising grass and fodder, fruit, fuelwood and timber. The wastelands, not covered under social forestry programmes should be developed by the Animal Husbandry Departments for additional grazing and production of hay.

6.6.15 While formulating programmes of social forestry in lands on the sides of roads, canal banks and railways lines, as recommended in the Interim Report on Social Forestry, due regard should be given to the growing of grasses and fodder along with trees. Available land in possession of Government, consolidated where necessary, in blocks over 200 ha should be taken up progressively for development as rangelands by Animal Husbandry and Sheep Development

Departments. Where the work is to be entrusted to the Forest Department, there should be a regular consultation between the concerned officers of these departments. Large blocks of Government rangelands, located far away from habitations, should be developed as grass reserves for hay making and this could be entrusted to the Forest Department, if necessary. The village panchayats and individual farmers should be encouraged to conserve grass on a cooperative basis. Government lands, developed as grazing lands, should also serve as demonstration plots to the village panchayats and farmers. All extension media should be used to educate the farmers on the need for proper protection and regulated utilisation of grasslands. In order that grassland development may become economical, the programme may be combined with that of the improvement of livestock so that the produce from land is fed to the high yielding stock and, thereby, better return is obtained in the form of livestock and dairy products.

Tree and Shrubs Leaves as Fodder

6.6.16 In times of fodder shortage, especially in hilly and drought prone areas, leaf fodder from shrubs and trees become the scarcity fodder particularly for cattle and buffaloes, which are generally fed on cultivated fodders and agricultural byproducts. No care has, however, been taken in regulating lopping of trees. Planting of fodder trees on farm boundaries, village surroundings, along road sides, railway tracts, canal banks and in grasslands should be encouraged as part of social forestry. At the same time, to improve the feeding value of various leaf fodder materials, the Indian Veterinary Research Institute (IVRI), the National Dairy Research Institute (NDRI) and the agricultural universities should undertake trials to find out the nutritional values of leaves of fodder trees. The Directorate of Extension of the Union Ministry of Agriculture and Irrigation should also undertake popularisation of the feeding of tree leaves to livestock through audiovisual aid and farm information bulletins, giving hints on methods of growing fodder trees and proper and timely pruning and lopping.

Seeds of Fodder Crops

6.6.17 The nonavailability of improved seeds of different fodder varieties has been, and still is one of the major constraints hampering fodder and grassland development activities. Even now, there is no organised industry for production, certification and distribution

of seeds of herbage and fodder plants. The problems of seed production in general, which have been discussed in Chapter 10, are equally relevant in the case of fodder crops seed production. Some special aspects, however, need attention. The responsibility of organising production of breeder seeds and coordinating this work should be with the ICAR, which should take immediate steps for streamlining the production of breeder seeds of the fodder varieties already evolved so that the agencies like NSC, Regional Forage Production-cum-Demonstration Stations etc. could start seed multiplication. The State seed corporations, wherever they exist, should take up production of foundation and certified seeds of fodder crops, and should develop their own seed certification agency. The services of the various seed corporations, seed cooperatives, seed growers' organisations, agroindustries corporations and private agencies should be utilised for the production and distribution of certified seeds. Registered growers should be encouraged by means of incentives to produce seeds of fodder crops. The State Governments should develop a machinery for proper check and quality control of seeds produced by all the agencies engaged in seed production. Till such time as separate agencies and organisations are created in the States for multiplication of fodder seeds, all available facilities and infrastructure should be utilised to the maximum extent possible. The existing fodder crop seed production farms should be provided with necessary inputs like machinery, equipment, staff etc. so that maximum production could be achieved. It is also necessary to establish additional fodder seed production farms since the existing ones will not be able to meet the large requirements of foundation and certified seeds. A regular and constant demand for quality seeds should be created among cultivators through a vigorous extension programme including actual demonstrations on the farmers' fields. The minikit demonstration programme on fodder crops should be initiated on the lines of the 'Rice Minikit Programme' conducted by the Department of Agriculture in order to popularise new high yielding varieties and cover a large number of farmers. Proper storage arrangements for seeds, specially of grasses, should be made at each district headquarters since these quickly lose viability unless properly stored; and they should be supplied to farmers well in advance of sowing time.

Organisational Aspect

6.6.18 In a vast country like India with diverse agroclimatic conditions, the requirements of research in fodder of each region of the

country would be specific and different. Special research projects should, therefore, be undertaken to cater to the needs of each region. At present, the emphasis laid on research work on fodder crop in the agricultural universities is not uniform. The universities should create a separate department or unit to deal with fodder of all types in an integrated manner.

6.6.19 Currently, the Departments of Animal Husbandry in most States are responsible for fodder development, but the existing set-up of the departments in regard to fodder development is extremely inadequate. Considering the magnitude of the task, a much stronger organisation should be set up in each State, down to the field level. Since the management of fodder crops is difficult and complex, and requires a thorough knowledge of the crop and techniques of soil and water management, the Department of Agriculture should undertake this responsibility. A strong base should be created for undertaking a massive extension programme on fodder crops in order that targeted production of green fodder could be achieved.

6.6.20 The programmes of rangeland development and management, grass reserves and mixed forestry with grass and fodder development envisage the coverage of a vast area. In order to handle these programmes effectively, it would be necessary to strengthen the Forest, Animal Husbandry and Sheep Development Departments. Where a large programme of grassland development is taken up by the Forest Department, they should employ adequate number of agrostologists, agronomists and range management specialists. Once the programme of grassland development, including grass reserves, is taken up by the Forest Department, the areas should on no account be converted later into forest plantations. Where large areas are taken up for grassland development by the Animal Husbandry and Sheep Development Department, a separate wing should be created in these departments. It is extremely important that adequate funds are provided for taking up the grassland development programme on the same lines as suggested in the Interim Report on Desert Development.

6.6.21 Since grassland development is a specialised job, adequate number of specialists should be trained within the country as well as abroad to man the higher supervisory cadres, to whom all development work should be entrusted. At the Central level, the fodder and grassland development unit in the Department of Agriculture should be strengthened to meet the requirements of the much enlarged programmes visualised.

6.6.22 As both cultivated fodder and grassland development are necessary for implementation of the livestock development programme in every State there should be a machinery for proper coordination

and implementation of cultivated fodder and grassland areas. This can be best organised by setting up a standing coordination committee in each State, as already recommended in the Interim Report on Desert Development. Every State should also constitute a State level standing committee for the proper planning and execution of the fodder and grassland development programme. Similar coordination committees should be set up at the district level with representation from the various concerned departments under the chairmanship of the Chief Agriculture Development Officer.

7 SERICULTURE

6.7.1 In the field of sericulture, India is the only country producing all the four kinds of silk, viz., mulberry, *tasar*, *eri* and *muga*. Mulberry silk, which is most important in the world production of silk, has a dominant position in the country as well. Of the total production of raw silk, mulberry, *tasar*, *eri* and *muga* account for 78, 12, 7 and 3 per cent respectively. Karnataka contributes 82 per cent of mulberry silk production; the share of West Bengal and Jammu & Kashmir being 15 and 2 per cent respectively. In the production of *tasar* silk, Madhya Pradesh and Bihar account for 44 and 49 per cent respectively, the adjoining areas of West Bengal and Orissa contributing 2 and 4 per cent respectively. Ninety six per cent of *eri* silk production is in Assam region and 2.1 per cent in West Bengal. *Muga* production is wholly in Assam region.

6.7.2 The production of silk fabrics in the country in 1971 was 39 million sq metres, of which the quantity exported was only 4.5 million sq metres. Over the years, and till recently, silk production even for internal consumption has been sustained through tariff protection against competition from China and Japan which almost crippled the sericulture industry. Compared to Japan, the performance of silkworms in India is poorer and the quality and efficiency of mulberry leaves very much lower. In Karnataka about 80 per cent of mulberry area is rainfed, and the yield of leaves is as low as 3 tonnes/ha. Under irrigated conditions, the yield can go up to 15 tonnes/ha which compares very favourably with that in Japan. In the Commission's Interim Report on Sericulture, it has been recommended that irrigated mulberry should replace rainfed mulberry in as large an area as possible. There is also need for better quality of mulberry leaves being produced through research.

The Central Silk Board

6.7.3 The Central Silk Board coordinates the development of sericulture industry in different States and advises the Government of India on policies governing export of silk goods and import of raw silk and silkworm seed. The Board is also responsible for organising sericultural research, training and basic seed (egg) production.

6.7.4 Research on sericulture has resulted in the successful production of highly productive bivoltine hybrids in Karnataka, which yield internationally acceptable high grade silk, and in the release of an improved strain of mulberry by the Central Sericultural Research and Training Institute, Mysore, which gives 20 per cent more yield than the existing varieties. Agronomical research on mulberry has shown that by proper manuring and soil moisture conservation, the average levels of mulberry yields could easily be doubled in irrigated areas. Research on *tasar* has established the possibility of controlled rearing of newly hatched worm during first 10 days resulting in the cocoon yield increasing by 40 per cent over the traditional methods of complete outdoor rearing. This technique is being popularised in the traditional areas of Bihar, Orissa and adjoining parts. In order to make the new methods of rearing more effective, the Central Silk Board has been advocating natural and artificial regeneration of the conventional food plants in consolidated blocks.

6.7.5 A new hybrid, synthesised by the Tasar Research Centre at Titabar, Assam thrives well on oak and produces *tasar* of a high quality. It is also amenable to domestication. The development of this *tasar* hybrid has opened up new opportunities for extending *tasar* cultivation in the entire oak belt, which extends from Manipur in the east to Jammu & Kashmir in the west along the Himalayas. The total area of this oak belt is estimated to be about 800,000 ha.

6.7.6 To extend moriculture, the Central Silk Board has undertaken through respective State Governments, a number of promotional measures including the setting up of hill stations for silkworm rearing, mulberry nurseries, seed farms, grainages, demonstration centres, chawkie (young worm rearing) centres, incubation centres, training centres, organisation of cooperatives and creation of markets. The Central Silk Board has also established a Raw Silk Price Stabilisation Authority as a measure of market stabilisation and a Raw Material Bank for *tasar* cocoons and *tasar* waste. The Board is concerned with control of quality of mulberry silk fabrics and *tasar* fabrics for export. In West Bengal a rational pricing system operates for ensuring quality control in cocoon transactions. There is need to introduce in other States a system similar to the one operating in West Bengal.

Extending Sericulture to New Areas

6.7.7 Climatologically, moriculture is being practiced under diverse conditions from the temperate climate of Kashmir to the warm and humid climate of West Bengal and the warm and dry conditions of Karnataka. In the hilly regions, mulberry is found in a tree form while it is raised as a cultivated bush crop in the plains. Mulberry cultivation should not present a problem wherever there is either assured rainfall or irrigation facilities. Even so, it is better if feasibility trials are conducted in order to locate areas where mulberry can be grown successfully. Once such areas have been located, it will be necessary to undertake studies on the successful rearing of silkworm in these areas. Any large scale introduction of moriculture would, however, need, the taking of many broods of mulberry silkworm in a year. The principle, which should determine the extension of moriculture, is that it should not unnecessarily encroach on other kinds of sericulture e.g. *eri* and *muga* in Assam or *tasar* in Bihar and Orissa. However, if certain pockets in these States could be developed profitably for moriculture, encroachment may be allowed as an exception. Keeping this in view, moriculture should be studied for adoption wherever possible, in the States of Himachal Pradesh, Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, Orissa, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu and Kerala.

6.7.8 Ericulture is concentrated almost entirely in Assam where castor is not cultivated but found wild. It is desirable to study the technological developments that can make ericulture a paying proposition in major castor growing States of Andhra Pradesh, Gujarat, Orissa, Karnataka and Tamil Nadu. The possibility of extending ericulture in Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar and Maharashtra, could also be explored. So far as *muga* culture is concerned, possibility of extending it to all the States of the north eastern region and also to the west coast comprising Kerala, coastal Karnataka, Goa and Konkan has to be examined.

6.7.9 Before the areas under different kinds of sericulture are extended, research should be undertaken in addition to feasibility trials, to explore as to how best community rearing of mulberry and castor silkworms with airconditioned facilities can be introduced, wherever the weather conditions so necessitate. The State Governments concerned have to render assistance in establishing and running the air-conditioned houses. In the case of castor plant, dual purpose varieties and practices will have to be evolved, which can give good yield of leaf as well as seed. Artificial feeding powder with castor leaf has also to be developed for castor worm, as in Japan. The quality of mulberry leaves will also have to be improved. All such research work should be done with the involvement of the agricultural universi-

ties of the areas concerned and, for this purpose, coordinated programmes have to be drawn up by the Central Silk Board and its research stations in consultation with the universities. Natural and artificial regeneration of the conventional host plants, e.g. *arjun*, *sasan*, *sal*, should be encouraged in consolidated blocks by the State Forest Departments in the traditional *tasar* areas of the central parts of the country.

Multiplication and Distribution of Silkworm Seed

6.7.10 Seed multiplication and distribution is a prerequisite to the development of sericulture on a very large scale. A system has to be evolved under which multiplication and distribution of all silkworms are undertaken on a uniform basis throughout the country. At present, the responsibilities between various agencies concerned are not precisely demarcated. The Central Silk Board should organise seed multiplication and distribution throughout the country for all the four kinds of silkworms on a common pattern and coordinate the same at the all India level. In order to maintain the best of stocks, import of exotic strains has to be continued judiciously. Production of P3 seed should be the direct responsibility of the Board, and of P2 seed that of the State Governments. The production of PI and FI seed should be left to cooperatives, private organised agencies or individuals.

6.7.11 The supply of young silkworms (chawkie) after the 2nd instar, instead of the seed, is universally accepted as positively beneficial. Indoor rearing of *tasar* worm up to the 2nd instar is also being advocated for adoption on a mass scale in the traditional *tasar* growing areas. The method of chawkie rearing should, therefore, be popularised in all the four kinds of silk worm. Steps should be taken by the State Governments to encourage and organise gradually chawkie rearing through private organised agencies or individuals for supply to rearers in place of eggs. This means an addition of one more stage in the chain of multiplication programme, viz. that of certified chawkie worms. The aim should be to supply only healthy young worms to rearers, and not the eggs, in the case of all the four kinds of silkworms, viz. mulberry, *eri*, *tasar* and *muga*. A system of certification for chawkies will have to be developed and executed by the certification agency. An independent silk worm seed and chawkie certification agency should be set up in every State and the activities of these agencies should be regulated and coordinated at an apex level by a separate certification wing, to be created for this purpose in the Central Silk Board. A composite Central Silkworms Seed and Chawkie Act should be passed for the country as a whole.

Organisational Structure

6.7.12 Sericulture involves a chain of close knit activities starting from the raising of host plants to the rearing of worms and leading to cocoon production and silk reeling. In many countries the Department of Agriculture has a direct involvement in sericulture. In India, sericulture in most States is attached to the Department of Industries at the State level. As a result, efforts for improving sericulture have been without the involvement of the Department of Agriculture and the silk industry has not been able to stand on its own and progress rapidly. To become fully viable, sericulture has to form part of agriculture. The Central Silk Board should come under the Ministry of Agriculture and Irrigation and be reconstituted with representatives from the States, the ICAR, the Union Ministries of Agriculture and Irrigation, Industrial Development, Commerce (Foreign Trade), All India Khadi and Village Industries Commission and all India associations, if any, concerning sericulture seed business, private farmers and rearers and silk industry. There should also be a small executive panel constituted in the Central Board for speedy implementation of the Board's decisions. The Secretary of the Central Silk Board should preferably be technically qualified and have the status of a Joint Secretary to the Government of India. There is already a provision in the Central Silk Board Act, 1948 for the levy of cess on raw silk. Such a cess was not levied due to the poor state of the industry. It can be levied for the benefit of the Board, when the industry shows signs of viability.

6.7.13 While the institutions under the Central Silk Board and their programmes may continue as before, the ICAR, together with its institutions and agricultural universities, have to be drawn in more and more in future research activities. The Forest Research Institute, Dehra Dun has to be involved in the sericultural problems. The areas and extent of cooperation from these organisations may be decided upon by the Central Silk Board through periodic mutual discussions. In view of the technology gap in the fabrication of equipment for sericulture, researches on fibre and utilisation of byproducts, etc., a Central Sericulture Technological Research Laboratory may be set up.

6.7.14 The agricultural universities should start research, teaching and extension activities in sericulture. It will be necessary to start a sericulture unit for this purpose. This unit may take the form of a fullfledged division in major sericultural States or it may just be a subdivision of the Entomology Division in other States.

6.7.15 There should be arrangements for short term inservice training of junior staff and familiarisation training of farmers and

rearers, etc. This work should be the responsibility of the Department of Agriculture. Industrial aspects of training programmes should be looked after by the sericultural sections of the Department of Industry. The training institutions which already exist under the Central Silk Board should continue their work for all India activities.

8 APICULTURE

6.8.1 There is need to harness the bee fauna of the country not only to produce honey but also to increase crop production through pollination. The Directorate of Beekeeping of the All India Khadi and Village Industries Commission through its Central Bee Research Institutes has been organising research and developmental work on various aspects of beekeeping with a view to extending modern apiculture to every village. Research is being undertaken on all species of honeybees with particular reference to the domestication of rockbee, whose yield potential is very high. Techniques for raising pedigree queens have been standardised. Breeding of bees and their supply to bee keepers are being undertaken by the Central Bee Research Institute. A cadre of field staff has been created by the Khadi Commission to train beekeepers in the villages in various aspects of bee management. In States like Kerala, Tamil Nadu, Karnataka and Maharashtra, progressive beekeepers have organised themselves into cooperatives some of which are functioning effectively in procuring, storing, processing, packing and marketing of honey and beeswax. There are also organisations for the manufacture of bee boxes and other equipment.

Scope for Increasing Honey Yields through Organised Apiculture

6.8.2 Only about 30,000 villages (5 per cent) are covered by apiculture, their being about 140,000 beekeepers and 500,000 bee colonies, the number of bee colonies per beekeeper and per village being 3 and 16 respectively. The total honey production (reported) is estimated at 2,300 tonnes and honey per colony at 5 kg. If apiculture is extended to every village, it may be necessary to develop 6 million bee colonies in modern apiaries at an average rate of 10 colonies per village. As technology develops, the present annual yield of honey of 5 kg per colony could be doubled by developing and harnessing bee fauna, both for honey and crop production. This task would mean an annual production of 60,000 tonnes in 2000 AD; the training of 2 million nabiary men and the creation of needed

capacity for handling, processing, transporting and marketing honey and its byproducts. The increase in the number of bee colonies will give rise to the problem of bee forage and the need to organise migration of bees from the forest to the field during monsoon season and thereafter.

Induction of Apiculture as an Organised Activity to the Benefit of Crop Production

6.8.3 Available data indicate that bee pollination increases crop yield in the case of highly crossfertilised or particularly selfsterile crops. In the case of fruits and orchard crops, bee pollination may also improve the quality of fruits due to the effect of pollengrains on the embryonic and/or maternal tissues. In the case of crops, which have varying degrees of selfsterility (e.g. mustard, gingelly, niger, safflower, cloves, almonds, etc.) any amount of fertilisers, irrigation or cultural care may not give a fraction of their potential yield unless bees are provided during the flowering period. In fact, one third of the total cropped area of the country is under insect pollinated crops, where bees have a great role to play. In this regard, the impact of man-made apiaries by themselves on crop production will be insufficient unless natural fauna of honeybees is also fully utilised. All possible efforts, should, therefore, be made to protect and multiply the natural bee fauna. In order to encourage the multiplication of bee colonies in Nature, natural flora will have to be developed all around. A detailed survey of the vegetation of forests and other areas with regard to their floristic composition is required to be done. One has to evaluate the utility of local flora to bees as nectar or pollen sources. Efforts have also to be made to introduce from various countries bee plants of proven utility to enrich the bee forage and fill up floral gaps. It is also necessary to breed mutually compatible varieties of bees and crop plants, use such insecticides and employ such plant protection methods as are least harmful to bees and lay-down agronomic and plant protection schedule favourable to the survival of bees.

6.8.4 The All India Khadi and Village Industries Commission has developed a well coordinated system of production, collection and marketing of honey and also organised research work necessary in this regard. The infrastructure and expertise available with the Commission and the State boards should be fully utilised to increase the production of honey and honey products. The Departments of Agriculture at the Centre and in the States have to participate with or support the Khadi Commission in all the developmental and extension activities up to the village level. The Departments of Horticul-

ture and Forest will have to work in collaboration with the Khadi Commission for the planning of orchards and forest trees respectively in the interest of bee fauna. The Forest Departments have a significant role in the protection of honey bees in the forest areas.

6.8.5 The Central Bee Research Institute is undertaking research on honey bee, bee flora and honey technology. The agricultural universities will have to participate more actively in this task and strengthen apicultural research. Apicultural education and training needs will also increase in future. It is, therefore, desirable to develop a section on apiculture in the entomology divisions of the agricultural universities. The divisions of plant breeding and agronomy should also take due interest in the relevant aspect of apiculture. The Central Bee Research Institute has to be developed, both in the field of research as well as training, and given the status of the Central Institute of the ICAR. Also, the Central Bee Research Institute and the agricultural universities should develop an understanding in regard to their respective work programme. The queenbee multiplication stations in every State could be attached to the universities, but the facility should also be available to the Central Institute which should exercise full control on the methods and quality of queenbee production. The FRI Dehra Dun should be associated with research in forest vegetation. It should indicate specifically the type of vegetation from the point of view of bee fauna in different types of forests including the lands which are going to be put under social and production forestry and roadside plantations. A committee for policy and coordination should be formed in every State representing the agricultural university, Department of Agriculture, Horticulture and Forest, the Khadi and Village Industries Board and private beekeepers or their cooperatives. Similarly there should be a central committee consisting of representatives from the ICAR, Union Ministry of Agriculture and Irrigation, FRI Dehra Dun, Khadi and Village Industries Commission, State committees and All India Beekeepers Association.

APPENDIX 6·1
(Paragraph 6 O.O)
Area and Yield Targets - 2000 AD

Area - Mha
 Yield - tonnes/ha

Crop	Area		Yield	
	Present	2000 AD	Present	2000 AD
1	2	3	4	5
foodgrain crops				
wheat	18·01	17·55	1·30	3·64
barley	2·58	5·50	1·03	1·97
oat	—	0·50	—	4·00
rice	37·54	32·00	1·11	3·04
maize	5·78	9·00	1·05	2·65
jowar	17·59	17·00	0·49	1·20
bajra	12·39	12·00	0·50	1·25
ragi	2·55	2·50	0·84	2·10
small millets	4·68	2·00	0·38	0·75
gram	7·91	8·50	0·64	1·50
pigeonpea	2·35	3·00	0·71	1·50
pea	0·90	1·00	0·76	1·50
lentil	0·78	0·80	0·51	1·50
lathyrus	1·70	1·70	0·52	1·50
other rabi pulses	1·94	2·00	0·37	1·50
other kharif pulses	6·57	8·00	0·25	1·50
total area	123·27	123·05		
commercial crops				
groundnut	7·23	9·00	0·78	1·50
sesamum	2·38	3·00	0·21	0·60
niger	0·48	1·50	0·24	0·50
castor	0·42	1·00	0·34	1·00
brassicas	3·36	4·00	0·50	1·00
linseed	1·88	2·00	0·26	0·50
safflower	0·59	2·00	0·24	0·50
soyabean	—	1·00	—	1·00
sunflower	—	2·00	—	1·00
sugarcane	2·59	5·00	49·00	82·00
sugarbeet	—	0·50	—	40·00
tobacco	0·45	0·55	0·83	1·50
cotton	7·60	11·50	0·12	0·46
jute	0·78	1·00	1·26	2·60
mesta	0·32	0·32	0·66	1·25
ramie	—	0·01	—	—
sannhemp	0·17	0·17	0·38	0·76

1	2	3	4	5
flax	—	0.005	—	—
agave	0.003	0.02	0.80	2.50
total area	28.253	44.575		
horticultural crops				
fruit crops	1.80	4.00	—	—
potato	0.49	1.50	9.00	20.00
sweet potato	0.23	0.50	8.00	20.00
tapioca	0.35	1.00	15.50	40.00
onion	0.16	0.16	10.00	20.00
garlic	0.025	0.025	4.00	10.00
vegetables	0.90	4.00	—	20.00
ginger	0.027	0.027	1.30	2.50
turmeric	0.076	0.076	1.90	3.50
chillies	0.73	0.73	0.62	1.24
coriander	0.28	0.28	0.39	0.80
flowers	5.068	12.798	—	—
total area	5.068	12.798	—	
plantation crops				
tea	0.35	0.45		
coffee	0.14	0.20		
cardamom	0.076	0.08		
pepper	0.12	0.12		
rubber	0.20	0.38		
cashewnut	0.22	0.35		
arecanut	0.17	0.17		
coconut	1.05	1.05		
oil palm	—	0.25		
total area	2.327	2.840		

ANIMAL HUSBANDRY

1 CATTLE AND BUFFALOES

7.1.1 There is tremendous potentiality for cattle development in India in the overall plans for rapid economic growth and desirable social changes. If cattle and buffalo development programme are pursued with vigour, the commodities available from these animals will in future meet not only the increasing domestic demand but promote possibilities for export and import substitutes. This will greatly enhance the scope for income and employment in rural economy.

Cattle Development

7.1.2 During the First Five Year Plan, the Key Village Scheme (KVS) was the main plank for cattle development. Its basic objective was the multiplication of superior germplasm from the established farms in selected compact areas in breeding tracts. The scheme envisaged a multifaceted approach to cattle development by giving simultaneous attention to better breeding, improved feeding, effective disease control measures, scientific management practices and organised marketing facilities. The scheme was considerably expanded during the first two plan periods, when the Government of India was sharing expenditure with the States. During the Third Plan, it was transferred to the State sector and direct financial assistance from the Government of India was discontinued. This change in the pattern of financial allocation affected to a large extent the provision of adequate inputs and services. The various reviews made on this scheme in recent years showed that important items of work, such as feed and fodder development and cooperative marketing of milk, were not being attended to for want of sufficient budget provision; even the equipment and other requirements for artificial insemination (AI) were not made available adequately.

7.1.3 Considering the fact that about 600 Key Village blocks are functioning at present, catering to progressive development in productivity of nearly six million breedable cow and she-buffalo population,

and quite sizable investments have been made in this project, this scheme deserves much more importance and attention than what it receives currently at the hands of both the Central and State Governments. The working of the KVS should again be quickly reappraised by a team of experts and proper guidelines for its future functioning should be laid down.

7.1.4 Experience with the Key Village Project had shown that, by and large, it had failed to produce the desired impact and that the large number of dairy plants set up during the Second and Third Plans were not able to collect sufficient quantities of milk. These considerations led to the formulation of the Intensive Cattle Development Project (ICDP) as a part of the Special Development Programmes started during the later half of Third Plan. The Indian Institute of Management, Ahmedabad made a study on the working of ICDPs in 1967 by which time these projects had been in operation for a period of about 3 years. The Programme Evaluation Organisation of the Planning Commission also undertook an evaluation study of the ICDPs in 1970-71. The programme and the progress made under the ICDPs were further discussed at the Symposium held on Statistical Assessment of ICDPs by the Indian Society of Agricultural Statistics in December, 1972. Early action should be taken to implement the suggestions made in the above mentioned three studies. Particular emphasis should be laid on the involvement of State Agriculture Departments in fodder development programme, organisation of rural milk cooperative societies, periodical surveys and reviews for assessment and evaluation work.

7.1.5 In recent years it has been rightly realised that unless cross-breeding of indigenous cattle with exotic dairy breeds is undertaken in a big way, it will be impossible to bridge or even narrow the gap between the availability of and demand for milk in the country. The emphasis on future cattle and buffalo development should be on increasing milk production and improving the working efficiency of bullocks through planned breeding system.

7.1.6 By and large, the cattle breeding farms run by the State Governments have been able to raise purebred herds for supply of bulls and to serve as demonstration centres on cattle management and fodder production. The studies carried out by the Institute of Agricultural Research Statistics (IARS), showed that there was ample scope for improvement in these herds at livestock farms of the Central and State Governments as well as of some private institutions through genetic selection, which had not been exploited for lack of adoption of scientific breeding programmes. The IARS had estimated that for the satisfactory evaluation of a sire it had to be mated to at least 30 cows, and that, on an average, only one out of 10 sires would have

an index of 20 per cent above the herd average. A stock of 300 breeding cows in one or more herds would therefore be required for a successful progeny testing programme in order to have a reasonable chance of discovering one or two outstanding bulls from a set of 8 to 10 bulls tested at a time. An examination of the size of herds of some important indigenous breeds of cattle at the Government farms revealed that one major constraint in taking up progeny testing programme was the small size of herds. As nearly 60 per cent of the farms had herds of less than 60 animals each, it would be difficult to adopt a coordinated breeding programme even by linking up two or more farms located in the same agroclimatic area. In order to overcome this difficulty either the size of these herds should be increased or only one breed of cattle and/or buffaloes should be maintained on each farm.

7.1.7 Most of the cattle breeding farms need reorganisation and strengthening so that a planned breeding programme could be undertaken for effecting progressive genetic improvement. Each State Government should set up a team of animal breeding and farm management specialists to study the working of the existing cattle/buffalo breeding farms and to make comprehensive suggestions for their working on scientific and economical basis. Such of the small farms, which do not offer scope for maintaining a herd of sufficient size to take up a breeding programme either alone or in conjunction with other farms, should be closed down or utilised for maintaining other livestock.

7.1.8 The Union Ministry of Agriculture and Irrigation, while formulating cattle development programmes for the Fourth Plan, viewed with concern the lack of necessary resources with most of the existing livestock farms for attaining progressive genetic improvement methods. As a result, these farms were functioning at best as multiplication farms for purebred stock. The Ministry, therefore, decided to set up 6 large cattle breeding farms on its own and to select a few suitable cattle breeding farms in the States to implement a coordinated breeding project for genetic improvement in these herds through scientific breeding based mainly on progeny testing of bulls. Accordingly, the establishment of four cattle breeding farms, one each for Sindhi, Tharparkar, Jersey and Holstein breeds, and two buffalo breeding farms, one each for Murrah and Surti, was taken up. The progress made so far under these farms has been below the original expectations as none of the farms could develop the requisite herd size to start progeny testing programmes, etc. Such a long delay in stocking these farms with sufficient number of cows and bulls is a matter for concern. The setting up of large farms in new locations should be avoided in future unless it is assured that all facilities and finance would become available to set up the farms within a reasonable period of time..

7.1.9 The Union Ministry of Agriculture and Irrigation sponsored a scheme in the Fourth Plan for assisting the State Governments to build up facilities at selected farms for undertaking planned progeny testing programmes. Nine such farms are at present getting financial assistance. The Central Government should identify more farms and extend financial assistance to them for such a programme. The State Governments should be discouraged from spending funds on smaller farms or on establishment of farms with small herds. Farms for draught breeds should be set up where the breeds are of excellent quality, as in the area of Nagore breed.

Cattle Breeding Farms

7.1.10 The State and Central Governments have established herds of purebred Holstein-Friesian, Jersey and Red Dane. As the number of animals imported was limited, most of these farms have very small herds. Out of 39 herds, only 13 have 60 cows or more where some planned crossbreeding programmes could be adopted. The other herds are smaller, and as such may merely help in making available a few bulls. Wherever possible, the small herds may be combined to form a large herd at the most convenient farms. When more imports are made, new herds of small sizes should not be set up, rather the States should build up the existing herds to adequate size. There should be at least 150 cows/mature heifers at each of these farms to enable them to take up a proper breeding programme.

Military Dairy Farms

7.1.11 The Military Farms Directorate should examine their present crossbreeding policy in consultation with the leading animal breeding specialists in the country, and lay down a definite long range crossbreeding programme. This will enable them to develop genetically uniform and stable crossbred populations and supplement the efforts being made under large scale crossbreeding programmes in the rest of the country for increasing milk production. This should not imply, however, that the crossbred cattle at all the military farms should have the same level of exotic inheritance. The military farms are located in different agroclimatic conditions, and have varying feeds and fodder resources. On the basis of these considerations, the military farms can be categorised into groups that can maintain stocks of different levels of exotic inheritance at a satisfactory level of production and general health. In military farms, where stock could be raised with better feeding and management regimes, the crossbred stock could be of higher grades, say having 75 per cent exotic inheritance. The farms

having such facilities at medium levels might maintain stock at 62.5 per cent level and the remaining farms at 50 per cent of exotic inheritance. The present stock of crossbred animals could be grouped accordingly and shifted to the farms which are to multiply crossbreds of that type. In this manner the value of stock would get considerably enhanced as herds of stabilised crossbred population would get developed. After achieving this objective in a satisfactory manner, the military farms should take up studies on comparative performance of the different types of crossbreds and their adaptability in different agro-climatic regions by transferring and maintaining small herds of adequate size.

7.1.12 The above suggestion does not envisage any intricate research investigation but only systematic collection of data on production, reproduction performance, growth rate, mortality etc. Such studies will furnish useful information which can help in laying down a suitable cross-breeding policy for general use in different regions of the country. As earlier recommended by the Royal Commission on Agriculture (RCA), any additional expenditure, which these experiments might involve, should form a proper charge on the funds allocated for promotion of research, since the Military Farms Department may find it difficult to incur any extra expenditure on experimental work because these farms are primarily intended for economic milk production and are to run on commercial lines. The Union Ministry of Agriculture and Irrigation and the ICAR should, therefore, actively collaborate with the working of the crossbreeding programmes in the military dairy farms and should extend both expert advice and financial support for these experiments.

7.1.13 Military farms have achieved a good measure of success in their attempts to improve the productivity and the reproductive efficiency of both cows and buffaloes in their herds through better feeding and management practices and to economise on the cost of milk production. The experience and good results obtained in the military dairy farms should be made use of in production of purebred exotic bulls. The Military Farms Directorate should earmark one of its farms, like the one at Meerut which has got adequate facilities for housing and fodder production, for developing a purebred exotic cattle breeding farm. The Union Ministry of Agriculture and Irrigation should provide a large foundation herd of about 300 Holstein-Friesian cows. Such a step would overcome the long time lag that is experienced in starting a new farm with adequate facilities such as land, building, irrigation etc.

7.1.14 The military farms are at present producing nearly 5,000 crossbred calves and 1,500 buffalo calves every year. They need only 1,500 crossbred and 200 buffalo heifer calves for replacement of stock

and strengthening the herds. The remaining calves become surplus to their requirements every year. As the military farms are not in a position to rear them up to maturity/production because of non-availability of required facilities and economic considerations, the farm authorities usually offer surplus calves up to the age of 15 days free of cost to any individual or organisation. In view of the difficulties in rearing such young calves, no demands are forthcoming for them. A few years ago the Union Ministry of Agriculture and Irrigation formulated a project under which the Military Farms Directorate agreed to rear calves up to 1 or 2 years of age provided firm demands were made by the State Departments of Animal Husbandry or other institutions like gaushalas. However, this scheme did not make any headway. The demand for high yielding cows is on the increase and a large number of dairy projects have come into operation. Superior calves/cows are also needed for distribution to small and marginal farmers and agricultural labourers. The military farms could be one good source for making available superior heifers for distribution in these areas. The military farms have recently started on their own, six youngstock farms, where a limited number of superior cow calves and buffalo calves are reared up to maturity. Most of these may be required for the replacement of their herds. As the costs are high the demand from the public for purchase of these calves has been negligible. A large number of calves from the military farms thus go waste. It is necessary to find a way out as to how best this annual loss of potentially high yielders of milk could be avoided. One suggestion could be that the military farms should take up rearing of large number of superior heifer calves at their youngstock farms. It has been estimated by the Military Farms Directorate that the cost of rearing a calf up to 12 months of age under the existing conditions of management would amount to about Rs. 1,500. This will make calf rearing very uneconomical. The State Governments should convert some of their existing farms located in areas of surplus grass production into youngstock rearing farms, so that growing heifer calves could be maintained economically on grass and hay alone.

Gaushalas

7.1.15 Facilities available with selected gaushalas should be utilised for developing sizable herds of purebred cattle and for undertaking a cross-breeding programme for increased milk production. The Government of India should provide financial assistance for creating adequate facilities for meeting operational cost on such programmes. Gaushalas maintaining small herds, but otherwise having progressive management, should be assisted by the State Governments to strengthen

their herds for production of milk and quality bulls. Nonofficial institutions maintaining dairy herds and needing technical advice and financial support for increasing their herd size and milk production should also be included in the gaushala development programme.

Role of Indigenous Breeds of Cattle

7.1.16 Several parts of the country do not offer favourable environment for production of highly specialised dairy animals. In such areas, improvement of cattle should be brought about either by selective breeding among local types/breeds or through grading up using improved breeds from other regions of the country, which have similar environmental conditions. In large areas of nondescript cattle, which do not offer scope for marketing of milk and where the inputs and services for successful introduction of crossbreeding with exotic cattle cannot be extended, grading up of local cattle with superior bulls of breeds like Haryana, Sahiwal, Sindhi, Tharparkar, Kankrej etc. should be attempted with a view to helping farmers to replace progressively their low producing cattle by general utility type animals.

7.1.17 In tracts where there are specialised draught breeds of cattle, like Nagori in Rajasthan, Amritmahal and Halikar in Karnataka, Deoni in Maharashtra, selective breeding for draught quality should be promoted on a large scale, as the cattle breeders in these areas derive a large income by sale of good quality bullocks. Planned efforts should be made for improving the draught capacity as well as ensuring uniformity in the cattle population in these breeding tracts.

Artificial Insemination

7.1.18 Isolated attempts to try artificial insemination (AI) in cattle have been made in India since 1939. However, planned and comprehensive studies on AI with special reference to the Indian conditions were initiated in 1942 at the Indian Veterinary Research Institute (IVRI). Under this scheme, various aspects of AI, such as collection and preservation of semen, techniques of insemination and transport of semen to rural areas, were studied. These studies indicated that the method could be introduced in the country without much difficulty. The Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India at its Seventh (1946) and Eighth (1949) meetings recommended that extensive use of AI for genetic improvement should be attempted and that State Governments should open AI centres in selected areas having high density of cattle population and satisfactory transport facilities. However, with the experience gained in the adoption of AI in the last two decades or so, and improv-

ed communication facilities now available even in the rural areas it is advisable that large size AI centres should be organised on district or regional basis as this would result in economy in the maintenance of bulls and ensure their fuller utilisation. In such of those districts where communication facilities may not be satisfactory, two or more semen collection centres, each to cater to about 50 to 100 subcentres, may be set up. Each AI Centre should have a well-equipped laboratory and arrangements for quick and efficient collection, examination and storage of semen samples.

7.1.19 Different dilutors are being used in different centres as the responsibility of preparation of dilutors has been generally left to the officers in charge of the individual centres. There has been a tendency on their part to try different dilutors on experimental basis on their own. It is the farmer who stands to suffer if these extenders prove less successful than the conventional dilutors of proven value. New dilutors should not be used on field scale without proper trials under controlled conditions at a research institution. Until such time when preparation of extenders is taken up on a large commercial basis, the State Departments of Animal Husbandry should arrange for centralised manufacture of approved dilutors in well-equipped laboratories. The desirability of designating one of the centralised semen laboratories in a region and entrusting to it the responsibility of manufacturing and supplying extenders to different AI centres should be explored. Each State Department of Animal Husbandry should advocate the use of only one type of dilutors in a region and the same should be continued till such time the research workers in the State recommend a better substitute after controlled experiments both under laboratory and field conditions.

7.1.20 The tests and procedures adopted for evaluation of semen at AI centres also vary from State to State and differ even within a State. Uniformity of procedure both for routine and periodical testing should be laid down by each State Department of Animal Husbandry so that it may be possible to evaluate and compare the results achieved in different centres/States.

7.1.21 In most of the States the semen is despatched to the insemination units on every alternate day. In Uttar Pradesh, Delhi and in some AI centres of a few other States, semen is despatched to the insemination centres only twice a week or even at longer intervals and consequently the quality of semen used at village level in such places may not be good enough for obtaining a satisfactory conception rate. This may be particularly so in respect of extended buffalo semen. It is necessary that in order to maintain a satisfactory level of conception rate, semen from AI centres should be despatched daily or at the most

on alternate days. However, in areas, which are not easily accessible and semen cannot be supplied even on alternate days, the sub-centres should be provided with small sized refrigerators. Wherever possible, facilities of milk collection and transport of the dairy schemes should be availed of for transport of semen. This would not only economise on cost of transport but also help in transport of semen daily and at fixed time.

7.1.22 With the taking up of intensive projects like ICDP, Operation Flood Project (OFP), crossbreeding schemes and other programmes which envisage breeding of a large number of cattle in selected pockets in the country, the need for extending AI service to cover a large number of villages and cattle population is becoming more and more important. Experience in some of the existing projects has shown that dependence on Government employed Field Assistants alone would not be sufficient to achieve this objective. The insemination work in the rural areas could be entrusted to properly trained inseminators as is done in most of the developed countries. Such a system of entrusting insemination work to village educated youths would enable increased coverage, and economy in the provisions of AI services.

7.1.23 AI service is at present extended free of cost in most of the States with a view to encouraging cattle owners to bring their animals for insemination with the semen from improved bulls. Since this technique has now been in vogue for nearly three decades and the value of the service has been realised by the cattle owners, particularly in the milksheds of large dairy projects, a reasonable fee for insemination services should be levied. Insemination fee should be charged for the first insemination only, and subsequent two repeat inseminations should be free. Special fee should be charged for providing the AI services at the door of the farmers.

7.1.24 Even though AI has been in operation under a number of schemes and the farmers have, by and large, come to appreciate the efficiency and usefulness of this technique in cattle and buffalo breeding, it cannot be said that this system of breeding has received wide acceptance by the farmers in all the places or that the insemination services provided are fully utilised under the schemes. In many States the breeding coverage under the AI centres is very low. The Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation should investigate the causes for poor response to AI and suggest measures for increasing breeding coverage through the AI centres.

7.1.25 One factor which stands in the way of increasing the number of artificial inseminations in the rural areas is the large number of scrub bulls. It will require a massive effort on the part of the exten-

sion staff to convince the farmers on the need and importance of removal of scrub bulls from villages. The AI centres should maintain superior quality bulls, preferably proven sires where available, with a view to convincing the farmers of the advantages they will derive by breeding their cows and buffalows with such bulls. It should be ensured that insemination services are available from morning till evening, and on all the days in the week, so that no owner, who brings his cows for service, goes back without getting his animals inseminated. Wherever possible, arrangement should be made to provide AI service at the farmers door in villages covered by ICDPs and milksheds of dairy projects.

7.1.26 As the inseminator in the village is the key man on whom the success of the insemination services depends, it is essential that selection of personnel for this work should be made carefully. Only those who have an aptitude for this type of work should be appointed. With a view to keeping up their interest in the profession, sufficient incentives should be provided in the form of awards, prizes and suitable avenues of promotions. It is also necessary to ensure that in the areas where AI is to be introduced there is concentration of good cattle and the farmers are willing to take to improved techniques of cattle breeding and management. These areas should also be served adequately by dairy extension work.

7.1.27 From the inception of AI in the country, the AI centres were expected to adopt a system of follow up of insemination in a systematic and planned manner. Even as early as 1957, while reviewing the work of AI, the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry observed that there were great variations in the conception rates as reported by the different AI centres and in some cases the figures were unusually high. The main reason for these variations appeared to be that the method of working out the estimates was not uniform. Following its suggestion, the ICAR circulated a method to the State Governments for adoption. However, the methods adopted for evaluating the breeding efficiency and procedure for recording of inseminations continued to vary widely not only from State to State but also from centre to centre within a State. A uniform method of recording inseminations, estimation of results thereof and calculation of percentage of conception should be evolved by the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation in consultation with the States for adoption. Further, the officers-in-charge of AI centres should have thorough practical and theoretical training in AI and physiopathology of reproduction. A minimum training course of three months in these subjects is considered essential. For ensuring sufficient practical

knowledge for stock assistants and field inseminators, the training course should be at least for three months.

7.1.28 Introduction of frozen semen technique in AI should be planned carefully. Each State Government should depute three or four experienced AI officers for practical training in the organisation and management of a frozen semen station and in the field use of this technique. These officers, after training, should be entrusted with the responsibility of developing frozen semen stations in their respective States as training centres. As far as possible, standard procedures and equipment should be adopted in freezing and using the frozen semen.

Crossbreeding with Exotic Dairy Breeds

7.1.29 In all the cattle and dairy development projects, a clearcut breeding policy should be laid down in advance about the exotic breeds to be used, level of exotic inheritance to be reached, the type of crossbred bulls to be used for *inter se* mating etc. Crossbreeding policy should broadly aim at producing crossbred stock with 50 to 75 per cent exotic inheritance. Bulk of exotic inheritance should be obtained through Jersey breed. However, when efficient animal health coverage and adequate supply of feeds and fodder can be ensured Holstein-Friesian breed should also be used along with Jersey. In hilly regions of the north-eastern States where beef consumption is popular, heavier exotic breeds like Brown Swiss and Red Dane should be used for crossbreeding, provided grassland development and fodder production could be augmented in these areas.

7.1.30 Under the Fifth Plan, there is a proposal to set up 10 to 12 large exotic cattle breeding farms. These should be established in the States where there are no large exotic herds and where progressively more and more areas are to be brought under crossbreeding programmes. Each crossbreeding project should ensure that the exotic inheritance in the crossbreds is stabilised and maintained at the desired level.

7.1.31 If the policy in a State is to use crossbred bulls having exotic inheritance from a particular exotic breed and an indigenous breed, the State should have a planned breeding programme implemented in one of their large farms for producing crossbred foundation stock with the required level and type of exotic and indigenous inheritance. A Panel of Animal Geneticists should define the mechanics of undertaking a systematic progeny testing of bulls used in the crossbreeding areas.

7.1.32 Incentives should be given to encourage importation of

dairy cattle through individuals of Indian origin, who have settled abroad. The Government of India may provide foreign exchange to meet the cost of transport of animals from abroad, which can be recovered on rupee payment basis from the recipients. Coordination of work relating to collection of animals in foreign countries, their transportation and distribution to their respective recipients in India after inspection, quarantine and prophylactic vaccination may also be undertaken by Government.

The Buffalo

7.1.33 Proper information on various aspects including body weights, body measurements, etc. and general description in respect of the buffalo is either not available or when available, there is considerable discrepancy. A fresh review and a study in greater depth should be made for a more satisfactory breed classification of the Indian buffalo stock.

7.1.34 All the buffalo breeds in the country have been evolved with consideration of milk production characteristics and thus constitute only milk breeds. In the best interest of the country, the development of the buffalo for the future should be not only for the enhancement of milk production, which is at present its primary function, but also for production of quality meat. Attempts at improving the milk quality of all the buffalo breeds seem unnecessary. For improving the milk quality of the buffalo, major emphasis may be laid on the improvement of only two breeds, viz., the Murrah and the Surti. These breeds may also prove suitable as dual purpose breeds for both milk and meat production. Under the prevailing conditions, attempts at development of two distinctly separate breeds or 'types' of buffaloes one for milk and the other for meat do not seem to be advisable.

7.1.35 The programme for development of milk production in the cow and simultaneous organised large scale drive for milk production enhancement in the buffalo are not conflicting. The necessity for milk production enhancement is so great that all production potentials should be actively exploited for obtaining the maximum possible yield. Considerably greater attention, should be directed to the buffalo without delay for milk production enhancement. This would require enlargement and strengthening of the existing programmes as also initiation of additional programmes. Select buffalo herds of adequate size should be established and a concerted drive made to collect superior quality animals from various scattered sources. Carefully planned systematic breeding programmes, including that of

progeny testing of selected bulls, should be undertaken in these farms for progressive genetic improvement of the stock.

7.1.36 Wherever possible, studies on reproduction of the female buffalo should include study on animal behaviour during oestrus. This should be done with the particular objective of developing husbandry for accurate and early detection of oestrus. Agricultural universities should draw up short term and long term research programmes for studying reproduction and production obviously of the buffalo. Coordinated research programmes should be undertaken for study of some of the problems.

7.1.37 The Central and State Governments should critically re-examine the position of progeny testing programmes in buffaloes with a view to identifying the constraints that are impeding early implementation of the programmes and for taking remedial measures. Seed stock buffalo farms should be set up with large buffalo population in the States and in the Central Sector. Military dairy farms with good buffalo stock offer good prospects for establishment of such farms. In buffalo farms and research institutes, investigations and studies should be undertaken on a wider scale on early weaning of buffalo calves and their rearing on low cost calf starters. Research studies on the effect of feeding and husbandry on fattening of buffalo calves should be undertaken. Promotional activity for consumption of buffalo meat in the country and consumer educational programme should be undertaken on a countrywide scale and a deliberate and energetic drive made to develop trade in buffalo meat.

Milk Recording and Herd Books

7.1.38 Milk recording has not been satisfactory under any of the projects. The position in regard to milk recording work under the ICDP, KVS and other cattle development projects should be studied by a committee of experts to suggest suitable measures to improve the system as to provide reliable information. As the present dual control for milk recording is not working satisfactorily because of lack of co-ordination and duplication of efforts, the Milk Recording system should be so designed as to bring under the programme as large a number of milch animals as possible. It would be necessary to adopt owner-sampler systems to cover a large number of owners under the recording programmes within the project area. Farmers should be organised into herd improvement associations for implementation of the programme's.

7.1.39 The Herd Book Programme has not been successful in making any significant contribution to the improvement of breeds and

in benefiting the herds participating in the programme. A procedure for registration of all imported purebred cattle and their progeny should be evolved, and their herd books should be maintained by the Central Herd Book Organisation (CHBO).

7.1.40 Maintenance of herd books for cattle breeds like Sahiwal, Sindhi and Tharparkar and Murrah breed of buffaloes, which are used in many States, should be the responsibility of the Central organisation. Registration and maintenance of herd books in respect of breeds, whose breeding tracts are confined to a single State, should be the responsibility of the concerned State. To ensure adoption of uniform procedures of inspection, recording and registration, the CHBO may act as a coordinating agency. The CHBO in the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation should be suitably strengthened and headed by a wholetime Registrar. Herd book and milk recording cells should be organised under the State Animal Husbandry Departments.

Problems of City Milch Cattle

7.1.41 The serious problem of destruction of high yielding milch animals as well as their progenies is continuing in the big cities. The deleterious effect of this situation on the country's milk production potential was discussed in the Commission's Interim Report on Milk production. As recommended there, the Indian Dairy Corporation (IDR) in consultation with the Maharashtra and West Bengal Governments, should carry out an intensive survey of the present position of disposal of buffaloes when they go dry in the cities of Bombay and Calcutta. Also, suitable programmes for timely artificial breeding of she-buffaloes and their purchase when they go dry for transfer to the milksheds of dairy projects should be drawn up. As the measures suggested above will take a long time before the city milch cattle could be channelised in the rural areas and as this matter is of a very urgent nature, a network of insemination centres should be set up as an interim measure within the cities in areas of concentration of milch animals. Funds for establishing insemination centres and for financing the extension service should be provided by the IDC out of the OFP funds on a priority basis.

Cattle Insurance

7.1.42 Cattle insurance should be considered as one of the many important inputs and services required for success under the cattle development and milk production programme. The insurance agen-

cies and the project authorities should jointly prepare pilot projects on cattle insurance in collaboration with the credit giving institutions on areawise basis. In area where the General Insurance Corporation would take time in initiating cattle insurance, the cooperatives handling milk production and/or marketing or the project agencies should take up this activity.

7.1.43 In areas covered by projects such as SFDA/MFAL and OFP where regular cattle insurance has not been undertaken, an alternative system of creating a Cattle Mortality Risk Fund should be adopted. Similar efforts should also be made in districts covered by other cattle development and milk production projects. The insurance scheme should also cover working bullocks in the areas where cattle insurance for milch cattle is taken up.

Export Trade in Cattle and Buffaloes

7.1.44 In recent years, there has been an increasing interest in the purchase of cattle and buffaloes from India by countries like Yugoslavia, Bulgaria, the Philippines, Sri Lanka, Brazil, Kenya etc. With the growing realisation of the importance of the buffalo as a producer of milk and meat, more countries may look forward for importation of superior buffaloes from India for grading up their local stocks. The possibility of demands for superior types of crossbred cattle may also be expected when a large population of uniform and genetically stable types of crossbred cows has been developed. Another item that can be explored for export trade is frozen semen, particularly of buffaloes. There is, therefore, an urgent need for taking up promotional measures to build up export trade in cattle, buffaloes and other livestock. Alternatively, the Government of India may consider entrusting this function to an organisation like the IDC.

Policies and Programmes for Achieving Milk Production Targets

7.1.45 All programmes for development of cows and buffaloes should lay particular emphasis on increasing their milk production capacities in order to reach the level of estimated demand of milk, which envisages an increase in milk production from the present level of about 21.70 million tonnes to 44.17 million tonnes in 1985 and 64.40 million tonnes in 2000 AD. Milk production enhancement programmes, as for SFDA/MFAL projects, should also be started in districts to be covered by the Integrated Cattle Development-cum-Milk Marketing Projects and special area programmes. The propos-

ed cattle and buffalo development programmes should be taken up in about 150 selected districts by 1985 and in 200 selected districts by 2000 AD. The task of cattle development, milk collection, processing and marketing in the shape of an integrated project should be entrusted to a single agency, preferably a cooperative of the producers.

7.1.46 Since it will take some time to develop herds of exotic cows sufficient to take care of the annual replacement requirements by bulls for the crossbreeding programmes, the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation should assess annual requirements of exotic bulls and arrange foreign exchange for their importation. Possibilities of importing large quantities of frozen semen from bulls of above average quality through foreign assistance and bilateral collaboration programmes should also be explored.

2 DAIRY DEVELOPMENT

7.2.1 The present level of production of milk in the country is far short of requirements. As indicated in Chapter 3, the annual demand for milk and milk products is expected to range between 33.37 million tonnes (low) and 44.17 million tonnes (high) by 1985 and between 49.36 (low) and 64.40 (high) million tonnes by 2000 AD. The supply-demand imbalances in respect of milk and milk products would thus become greater unless appropriate corrective measures, as listed below, are taken simultaneously :

- (i) production of adequate quantity of milk to satisfy the market demand;
- (ii) development of efficient systems of movement of milk in fluid or in conserved form, particularly from poorly connected supply centres to the demand centres;
- (iii) adequate facility to conserve surplus milk in the flush-season for utilisation in the lean season; and
- (iv) rational pricing policy to encourage production of milk, particularly of cow milk.

7.2.2 The installed capacity of most of the milk products manufacturing plants at present is underutilised. With progressive increase in milk production, greater quantities of milk would be available for production of traditional and non-traditional milk products. The organised dairy sector should constantly keep these prospects in view so that keeping in step with growing market demands, these products may be manufactured in larger quantities. Several of these products

besides being absorbed in the local market have the potentiality of export.

7.2.3 Processes for utilisation of milk byproducts should be developed for commercial exploitation. Dairy and food research and other institutes should standardise methods of manufacture of milk food delicacies and undertake research studies for improving the storage life, flavour and taste of various traditional milk food delicacies and their packaging.

Marketing

7.2.4 The traditional channel of milk handling does not require an expensive infrastructure such as a dairy plant or other costly equipment, chilling station, refrigerated or insulated vans and employment of technically qualified staff with high salaries. Because of this, all possible permutations of these systems incorporate two features : (a) absence of elaborate and expensive facilities and therefore little capital investment per litre of capacity; and (b) absence of direct link between the producers and the consumers. Even when the demand-supply situation compels very high selling price, the producers get very little, the middlemen pocketing the lion's share. The organised dairies collect milk through one of the following systems : (a) directly from the producer's by establishing village procurement centres; (b) from the producers and middlemen alike by establishing milk collection and chilling centres; and (c) from primary cooperative societies. With the exception of (c), which directly connects the primary producers through their cooperatives with the marketing organisation, none of the others offers much of an improvement over the traditional unorganised dairy sector. Energetic steps should, therefore, be taken all over the country to establish strong cooperative organisations of primary milk producers.

7.2.5 The selection of the size of the chilling plant quite often poses a difficult problem for the dairy organisation. That the operational cost per litre of milk is lower with bigger sized plant, is well known, but while taking a decision on the size of the chilling plant, the extent of availability of milk is also a determining factor. A decision on the capacity of the chilling station should, therefore, be taken after carefully weighing various factors and keeping in view the primary consideration of economy. Indiscriminate setting up of small size milk chilling stations has, in several instances, only added to the cost of overheads without improving very much the procurement of milk. Chilling centres should, therefore, be set up by the dairy organisation only when unavoidable.

7.2.6 The process of building up a national milk grid should be expedited. This can best be done by the Central Government charging the IDC with the responsibility of organising the orderly evolution of the national milk grid. The IDC should collaborate with each participating State authority for the organisational arrangements required. As each State evolves its capacity to move milk and milk products and store these for balancing purposes, the sum total of the stored products can constitute the national pool.

7.2.7 Organised dairy industry is now poised for taking big strides for rapid growth and large scale development. Past experience in the operation and management of a number of city milk supply schemes has revealed that some of the systems of milk processing and dispensing that were adopted following the practice prevailing in many western countries are not quite suitable under the conditions existing in the country. Several optional systems of milk processing and dispensing have developed in the meantime. Some of these would possibly be more suitable for adoption with or without modification. Milk delivery system with different kinds of milk cans and, more particularly, with tamper proof sanitary milk cans with devices for delivery of measured quantities, should therefore, be given trial on a wider scale to determine the acceptability of the system to the consumers and convenience and economy of operation of the system. On the basis of the experience gained, further studies on designing and remodelling of the cans should be undertaken.

7.2.8 Detailed technoeconomic feasibility and consumer acceptance studies concerning processing, packaging and delivery of milk should be taken up by large city milk plants in collaboration with the National Dairy Development Board (NDDB), National Dairy Research Institute (NDRI) and other institutes having well developed dairy engineering workshops. Such studies would provide information for determining which system would be most suitable for adoption under a given set of conditions and facilitate decision making.

7.2.9 In the development of dairy organisation in the country, a subject which has remained much neglected so far, is the question of supply of milk and its products in rural areas. It is estimated that the per capita milk consumption in a given city is about 50 per cent greater than that in the hinterland milksheds of the city. The national objective of economic growth with social justice implies that urban-rural inequalities are to be reduced and the development of dairying must, therefore, be planned in a manner that would assist in the attainment of the objective. Consistent with this approach, as the development of dairying would be contributing towards increasing rural income in the selected milkshed areas, a system should be developed to

encourage consumption of milk in these areas. In the Kaira District Cooperative Milk Producers' Union, all the village milk procurement societies are selling milk to the village consumers at cost price. While city milk supply scheme is being planned arrangements should simultaneously be made for sale of milk in the concerned rural milkshed areas as well by the dairy organisation by adopting a system similar to that of the Kaira District Cooperative Milk Producers' Union.

7.2.10 Just as development of dairying is expected to increase productivity and income in selected rural areas where milk production can be most economical so will other programmes of modernised agriculture and industry increase the per capita income in other rural areas outside milksheds. With growing prosperity in such areas, the demand for milk also will be on the increase. Dairy development programmes should keep in view such prospective growth centres in nonmilkshed localities for organising an efficient marketing system for meeting the milk demands in such areas.

7.2.11 Consistent with demand-supply situation, a dairy organisation should adopt a pricing policy for milk procurement that would ensure an even supply of milk throughout the year. Dairy industry should accept the two-axis pricing policy for milk procurement, as this is rationally based on evaluation of both the fat and solids-not-fat content of milk.

7.2.12 The sale price of milk and its products should be fixed in a manner that would enable the organised dairy industry to pay remunerative price to the milk producers and meet the cost of collection, processing and distribution of milk and milk products. The sale price should also cover the cost of services rendered in connection with channelising the inputs for milk production, keep a fair margin of profit, and yet make the price of the commodities competitive.

7.2.13 An efficient milk pricing organisation should be set up in each dairy plant and in each State to fix the producer and consumer prices of milk from time to time. An inter-State authority should be established for the same purpose to coordinate the activities of the dairy plants that collect milk from more than one State. These and other recommendations contained in the report of the Milk Pricing Committee (1972), appointed by the Government of India, should soon be implemented.

Dairy Plant Management

7.2.14 Most of the dairy plants are managed by Governments or run by corporations established by the Government. The privately owned dairy plants remain on the periphery of the country's dairy

development. But they have also made some useful contributions to the development of dairy industry. So long as the private industries do not come in the way of development of cooperative organisation of milk producers, they should be allowed to function subject to their providing inputs for enhancement of milk production in their respective milkshed areas. For encouraging the milk producers to become share holders of joint stock companies working in the field of dairying, the companies should keep a stipulated minimum percentage of shares reserved for the milk producers. The companies should also have an effective representation of the milk producers on the board of management so that the interests of the producers are fully safeguarded.

7.2.15 As dairy development programmes can best be organised by the cooperatives of the milk producers, the producers should first be organised into primary/village level cooperative societies. Persons not involved in milk production, or those associated with private milk business, should not be allowed membership of these societies. The primary milk producers' societies should be federated into a district level milk producers' union.

7.2.16 The responsibility of forming the primary societies and the district unions should be entrusted to a team of specially trained persons with experience in the field of cooperative organisation. In the States, where complete cooperative structure of milk producers' unions does not exist but State Dairy Corporations have been formed, the Corporations should take up the functions of the unions that have not yet come into existence strictly as an interim measure. State Dairy Corporations should promote the formation of the complete structure of cooperative unions as early as possible and hand over the operations and facilities of the organisation to the unions as soon as those are established.

Manufacture of Dairy Equipment

7.2.17 The response of the manufacturing concerns in the country to meet the requirements of the growing dairy industry is quite commendable. There are, however, various complex problems, viz., import restrictions, high customs duties and problems connected with quality of local raw materials etc., that are impeding further growth of the manufacturing industry at present. In order that there may not be any setback to the dairy equipment manufacturing capacity developed in the country, these problems should be examined by the Government in collaboration with the NDDB/IDC and concerned or interested parties for taking necessary remedial measures. Although a large variety of dairy equipment is now being manufactured in the country, there are some sophisticated items which have not yet been

taken up for manufacture locally, e.g., separators and clarifiers of high capacity, homogenisers, large icecream freezers, heat exchangers, etc. The demand for such equipment at present is limited but with the expected accelerated growth of the industry the demand is bound to increase. Moreover, several of these equipment are used for other processing industries. The possibility of having these equipment manufactured indigenously should be explored.

7.2.18 At present some items of dairy equipment are being exported to foreign countries. In view of the expanding dairy industry of many developing countries there is scope for expansion of export market for the locally manufactured dairy equipment. The Government should negotiate with these countries to explore the possibilities for the supply and installation of complete dairy plants on turnkey basis, which should include advisory service and training of personnel. If considered necessary, a consortium of public and private equipment manufacturing firms may be established for this purpose. The IDC should be encouraged to enter the field of manufacture of dairy and allied equipment.

Administrative and Institutional Structure

7.2.19 For implementation of dairy modernisation on the scale recommended here, the institutional structure must increase its scope and effectiveness in anticipation of its mounting tasks. The composition of each institution must reflect the interests of those whom it should serve, with built-in stimuli to ensure social awareness and self supportive growth.

7.2.20 The Dairy Development Wing of the Union Ministry of Agriculture and Irrigation should be adequately strengthened to equip itself properly to meet the needs of increasing dairy development in country. The Ministry should not undertake commercial operation, and should absolve itself of the responsibility for the operation of the Delhi Milk Scheme.

7.2.21 In most of the States, several departments/directorates are looking after the work of milk production, health coverage, milk procurement and marketing. In some of the States, there are also 3 or 4 separate functionaries such as Directorate of Veterinary Services, Directorate of Animal Husbandry and Directorate of Dairy Development and the State Dairy Development Corporations. This multiplicity of departments, apart from increasing the cost and diluting the responsibility, has created confusion and interdepartmental rivalries. The State Governments should set up a unified department to deal with milk production, processing and marketing. Its functions should be to assist in the formulation of dairy policies and to monitor their

implementation. Execution of projects and, especially, operation of dairies should not be attempted by this department.

7.2.22 The State Dairy Development Corporations should build up the capacity for project designing and development and for co-ordinating the functioning of the respective State milk grids. The IDC should be strengthened so that it can function as a finance house and a promotional institution for speeding up modernisation of the organised dairy sector.

7.2.23 The NDDB has now developed significant capacities for project planning, processing and implementation. It is now in a position to offer complete facade of services including feasibility studies, execution of dairy projects on consultation/turnkey basis, organisation of milk producer cooperatives, consultancy services in the fields of dairy husbandry, milk processing, marketing and management. It also offers facilities for custom made training programmes for the development of manpower required to manage the various dairy development programmes. Over the years, the NDDB has also attracted in its fold high calibre technical personnel in different disciplines connected with dairy work.

7.2.24 Originally it was intended that NDDB should implement Operation Flood Project. However, because of its constitutional limitations, it was found that this responsibility could not be vested in them; hence the Indian Dairy Corporation was set up under the Companies Act. The NDDB and the IDC have a common Chairman and many of the Directors of the IDC are also the Members of the NDDB. The Board, in fact, has been working as the technical and development wing of the IDC. As a greater role of IDC is visualised in guiding and helping day to day operations in the country on a large scale even after the completion of the Operation Flood Project, it would be desirable for the IDC to have a strong research and development wing of its own. The NDDB may be merged with the IDC as its research and development wing. The integration of these two institutions is necessary as it would lead to integrated approach, better coordination and economy of the operations. The outstanding success of the NDDB was due to its operational freedom and the competent technical leadership it has enjoyed throughout. Even after merger of the Board with IDC, it should have the same freedom of operation as it has at present.

7.2.25 The reorganised Indian Dairy Corporation should continue to have technically qualified Chairman and Managing Director. The Board of Directors should also be constituted with persons professionally qualified in dairy, animal husbandry, management and finance.

7.2.26 Enforcement of Prevention of Food Adulteration Act should

be intensified to ensure that consumer confidence in milk and milk products obtained from organised dairy plants is not eroded by adulterated/imitation products. The draft of Milk and Milk Products Control Order which is under consideration of the Union Ministry of Agriculture and Irrigation, should be scrutinised expeditiously by the Ministry for early enactment of necessary measures.

3 SHEEP AND GOATS

Sheep

7.3.1 India possesses 40 million sheep (1972) and ranks sixth among the countries of the world in sheep population. However, as the average production of wool and mutton of the indigenous sheep is very low, the contribution of sheep to the national income is not very high (around Rs. 140 crores per annum). This low production of mutton and wool from the indigenous sheep is mainly due to the economic backwardness of shepherds, non-adoption of scientific methods of breeding, feeding and management, and extremely poor grazing resources.

7.3.2 Sheep raising is mainly in the hands of the weaker sections of the community which either do not possess land or their land holdings are so small that crop cultivation does not provide remunerative employment all the year round. Further, in the major sheep rearing areas grazing and stock watering resources are available only for a few months in a year, compelling shepherds to lead a nomadic life. With such a system of constant movement of sheep over long distances, the sheep owners are unable to adopt scientific methods of breeding for genetic improvement of stock. Shearing of sheep in distant places and sale of wool at far away markets do not give them any chance for organised collection, processing and marketing of wool, and the sheep-breeders are unable to bargain for a remunerative price. These difficulties could be alleviated if the State Animal Husbandry/Sheep and Wool Departments set up service centres on the migration routes.

7.3.3. Sheep normally do not require elaborate housing facilities but provision of suitable shelter, particularly for young lambs, pregnant ewes and breeding rams, will definitely increase productivity and reduce losses due to mortality. It is necessary to provide cheap shelters with thatched roofs made of locally available material with thorny fences. In areas normally experiencing extreme cold or hot winds, some protection against the winds should also be provided.

7.3.4 Very little information on the economics of sheep rearing in different agroclimatic regions is available at present. For purposes of

planning sheep development programmes, detailed information on economic aspects is necessary. The ICAR and agricultural universities should initiate studies in this direction.

7.3.5 The livestock census figures do not give break up of different categories of sheep like ewes, rams and young of the exotic, cross-bred and indigenous stock. Since these data are required for analysing the trends in sheep population and for determining the progress of the sheep development programmes the detailed information should be collected on a sample basis from the next census onwards.

7.3.6 Reliable estimates of production of wool in this country are lacking. The Union Ministry of Agriculture and Irrigation is contemplating to carry out systematic sample surveys simultaneously in all the States for estimation of production of livestock products, such as milk, eggs, meat, wool etc on a phased basis. This procedure should be followed on a regular basis for the estimation of wool production in all the States in the same year.

7.3.7. Every effort should be made to fully develop within the shortest possible time the State Sheep Breeding Farms, started during the Fourth Plan, as these Farms are to play a very important role in sheep development programmes through the supply of superior germplasm. Sheep to be imported should come from the regions having more or less the same type of climate that prevails in the areas where they are to be stationed in the country. Sheep for import should be selected from as large a number of flocks as possible to ensure greater genetic variability.

7.3.8 The level of exotic fine wool inheritance should be stabilised around 50 per cent in arid and semiarid areas and the crossing of exotic fine wool breeds with black faced indigenous breeds should be avoided. Since the All India Coordinated Research Project on Sheep Breeding is of great importance, necessary steps to remove bottlenecks and ensure its expeditious execution should be taken.

7.3.9 The total sheep population in Jammu and Kashmir, Himachal Pradesh, hilly regions of Uttar Pradesh, sheep of Chokla and Nali breeds in Rajasthan, Nali sheep in Haryana, Pattanwadi sheep in Gujarat, Nilgiri sheep of Nilgiri hills in Tamil Nadu and better type of wool sheep in Arunachal Pradesh may be brought under crossbreeding for fine wool production using Rambouillet and/or Merinos. Selective breeding among sheep of important carpet wool breeds in Rajasthan such as Marwari, Jaisalmeri, Pugal and Magra and among Marwari and other woolly sheep, except Pattanwadi in Gujarat, should be undertaken. A few large sheep breeding farm of Marwari, Jaisalmeri, Pugal and Magra breeds should be established in their respective home tracts. Since Indian carpet wools lack lustre, improvement

through selection or through crossing with carpet wool breeds from some middle eastern countries, which produce lustrous wool, may be undertaken by the ICAR on experimental basis. In view of great potentiality for export of mutton, work on evaluation of carcass quality, laboratory evaluation of meat quality and meat processing should be initiated on priority basis at the Central Sheep and Wool Research Institute (CSWRI), IVRI and in agricultural universities. The population of woolly type sheep in Haryana, Punjab, western Uttar Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Bihar should be crossed with exotic dual purpose breed like Corriedale to evolve a dual purpose breed for producing better carpet quality wool, better liveweight and higher dressing percentage. The hairy breeds other than Mandya and Nellore should be graded up with Nellore and Mandya. In Mandya and Nellore selective breeding based on six monthly body weight should be practised. It would be advisable to establish four large exotic sheep breeding farms in different regions of the country for undertaking crossbreeding with Corriedale.

7.3.10 Artificial insemination (AI) has played a significant role in improving sheep within a short period of time in Russia and in some western and eastern European countries. In India, this technique, though taken up on an experimental basis for some years, has not yet been extended to the field on a large scale, except in Rajasthan. Serious attempts should be made to try out this technique in the breeding of sheep in different parts of the country in view of the large scale crossbreeding programmes that have been recommended for rapid increase in wool and mutton production. Because of the paucity of rams of exotic breeds and difficulties in their use through natural service when maintained with the village flocks in the plains, AI in sheep is to be considered as a method more of necessity than of choice. Intensive researches should be carried out at the CSWRI, IVRI and in agricultural universities for improving the methods of semen dilution and preservation so that diluted semen could retain fertility for a longer period. As nonadoption of AI in sheep on a large scale is mainly due to the difficulty in semen preservation beyond 6-8 hours of collection, a quicker transport and more frequent supply of semen would have to be arranged, or AI Centres would have to be set up in the close vicinity of the breeding areas. Some flockowners or graziers in Rajasthan have been trained in detection of oestrus in ewes and for practising AI in flocks. This practice should be tried on an experimental basis in other important sheep rearing States. A few stationary as well as migratory flocks should be selected in the plains for this trial. Good quality semen and sterilised inseminating equipment

should be supplied to the owners of such flocks daily during the breeding season from a nearby AI Centre. In the case of migratory flocks in the hilly areas, as the migratory routes and the time of migration more or less fall in a definite pattern, mobile AI units should be organised with facilities for transporting breeding rams and insemination equipment. The important sheep rearing States should organise AI in sheep on a pilot basis in selected centres and if it proves to be a successs, it should be gradually extended to cover more areas and larger sheep population.

7.3.11 The most important and difficult problem facing the sheep industry is to meet the nutritional requirements of sheep population. To face the problem, it is necessary to develop arid and semiarid wastelands into pastures and provide sufficient top feed through plantation of suitable fodder trees, utilise various agricultural and industrial by-products, conserve fodders and to increase production of coarse grains for meeting the requirements of highly productive sheep. The development of village grazing lands should be entrusted to the village panchayats or Sheep Breeders' Cooperatives.

7.3.12 In addition to the development of pastures and range lands in arid areas, improvement of natural pastures in States like Himachal Pradesh, Jammu and Kashmir and hilly areas of Uttar Pradesh and southern States should be undertaken through reseeding and application of fertilisers. Further, large blocks of Government range lands located far away from villages should be developed mainly as grass reserves for hay making. It would be necessary to include fodder crops, especially leguminous fodders, in the cropping pattern in irrigated areas. The feed compounding industry should manufacture cheap supplementary rations for sheep utilising agricultural and industrial wastes and nonprotein nitrogenous substances.

7.3.13 Certain minerals like sulphur, copper, cobalt and zinc are of special significance in sheep nutrition for wool production. There is an urgent need to carry out survey on the micronutrient status of soils and plants including fodder and their availability to sheep in areas of intensive sheep rearing and investigate the effects of their absence.

7.3.14 Some sheep diseases which have recently assumed considerable importance are blue tongue and infectious epididymitis. Blue tongue at present appears to be confined to a small area. It is highly important that stringent steps are taken to eradicate the infection. The Ministry of Agriculture and Irrigation should lay down a policy for its eradication. The IVRI should initiate research work on this disease and should keep itself in readiness to start the manufacture of blue tongue virus vaccine, whenever required.

7.3.15 Infectious epididymitis has become a serious problem at some of the exotic sheep farms. The IVRI and agricultural univer-

sities should undertake a systematic survey to determine its incidence at the different sheep farms in the country. The epizootiology, pathology and pathogenesis of the disease should be studied and suitable preventive measures should be devised for the guidance of breeding farms. The IVRI should undertake large scale manufacture of the irradiated vaccine against lung worm infestation for field use. Detailed studies on the pathology and pathogenesis of pneumonias in sheep should be carried out with a view to devising suitable preventive measures.

7.3.16 Sheep farmers should be educated by the sheep and wool extension agencies of State Animal Husbandry/Sheep Husbandry Departments on shearing practices and on skirting and primary classing. This would benefit the wool producers and also the wool industry. Wool is at present classified into 90 different grades. The present grading system is very cumbersome and should be revised to have lesser number of grades. It would be desirable to set up a Central Wool Testing Laboratory to provide wool testing services free, or on nominal charges, in all the wool producing states. Further, the wool grading system should be standardised, and graded wools evaluated for effectiveness of grading by means of physical characteristics and also for their manufacturing quality. Such studies should be carried out at the CSWRI in collaboration with the State Animal Husbandry/Sheep Husbandry Department. It will be advisable that the concerned State Government should enact suitable legislation to ensure that all the wool produced in the State is passed through the grading centres and that the grading and marketing should not be the responsibility of the State Animal Husbandry or Sheep Husbandry Department. These departments should primarily concentrate on sheep development activities.

7.3.17 There are no organised markets for wool. The present marketing system for wool allows very large profits to the brokers and other intermediate agents, and does not provide remunerative price to the sheep farmers. It is necessary to have organised wool markets by making the provisions of Agricultural Produce (Grading and Marking) Act, 1937, applicable to wool in the important wool producing States. Incentive may be given to induce the producers to bring clean and better quality wool for sale in the market. Necessary facilities for wool grading and warehousing should be provided in the regulated markets. Easy credit facilities should be made available to the sheep farmers so that they can avoid selling of wool to the *beoparies* at distressed prices.

7.3.18 The Act, under which warehouses are being set up both by the State and the Centre, does not include wool in the schedule of

commodities accepted by the warehouse. The Act should also cover wool and the wool markets should be preferably established near the major areas of production so that the sheep farmer can sell his produce directly in the market. It may also be desirable to organise sheep farmers' cooperatives for organising sale of wool and live animals and for extending credit facilities to the members and, thus, save them from the clutches of *beoparies* and money lenders.

7.3.19 There are no organised market yards for sheep. Animals are generally purchased by the middlemen and transported on foot or by trucks to the nearest slaughter house, where they are sold in lots. Since large slaughter houses and meat markets are located in metropolitan cities, animals have to be transported over long distances and to far off places. This involves considerable economic losses due to mortality and shrinkage in live weight. There is thus great need for providing market yards for the sale of live animals in major sheep rearing areas. The market yards should have facilities for feeding, watering and holding animals for a few days. Marketing yards, preferably with facilities for slaughter, meat packaging and utilisation of slaughter house byproducts should be set up in the major sheep rearing tracts. Meat marketing should be organised through sheep farmers' cooperatives.

7.3.20 Major part of the sheep and wool development activity has been hampered because of the involvement of the development staff in wool purchases. Further, the limitations imposed by Government purchase and disposal procedures create problems in the efficient running of such a marketing system. Either the sheep breeders should organise themselves into producers marketing cooperatives, handle the wool in an appropriate manner and bargain for better prices in an organised wool sale, or the States should set up an independent body to look after these activities.

7.3.21 In order to realise higher export earnings, progressive restrictions should be placed on export of raw wool and export of manufactured woollen goods should be encouraged. Wool production and manufacture of woollen goods and handwoven carpets should be tied up with the schemes of Handicrafts Boards/Khadi Boards functioning in the area and the procedure of payments of drawback claims of duty on woollen goods for export should be simplified. Shearing, flaying and curing of hides should be undertaken only by trained persons.

7.3.22. With the adoption of the proposed sheep development programmes and of modern techniques of breeding, and effecting improvement in the feed and fodder resources, better management practices and provision of an efficient health coverage, the sheep population will get considerably increased to about 45 million by 1985 and to 60 million by 2000 AD.

Goats

7.3.23 Goats are raised mainly for meat. No exotic germplasm is available for increasing the yield of meat since superior goat breeds found in foreign countries are essentially dairy breeds. Consequently, the approach for raising meat production from goats should be selective breeding among taller and medium sized breeds and outcrossing the nondescript types with selected meaty type bucks. In addition, proper management, fattening rations and better health cover should be provided.

7.3.24 In 1971-72 goats produced about 675 thousand tonnes of milk constituting 3 per cent of the total milk produced in the country. For increasing milk production, crossbreeding with exotic dairy breeds may be undertaken and milk capabilities of better indigenous dairy breeds like Jamnapari, Barbari and Beetal should be improved through selective breeding. This would require production of stud bucks for which some goat breeding farms should be set up and progeny testing work undertaken. In addition, bucks from high producing dams in flocks of progressive goat breeders may be selected and distributed among goat farmers. The progressive goat breeders may be advised to maintain milk records and other relevant information that may be helpful in selecting prospective bucks.

7.3.25 Production of Pashmina is confined to Ladakh and its annual production has been estimated to be of the order of 41,000 kg. Mohair is produced in very small quantities in Garhwal (Uttar Pradesh) and Himachal Pradesh. Both Pashmina and Mohair are in great demand in cottage industry and in the foreign markets. The ICAR has initiated on All India Coordinated Research Project for developing a strain of high Pashmina producing goats by crossing Tibetan Pashmina goats with exotic Pashmina goats to be imported from Russia. This work should be pursued vigorously.

7.3.26 Mohair gives about three times more profit than wool. An All India Coordinated Research Project for evolving such breeds by crossing with Angora is in progress in Uttar Pradesh and Maharashtra. The results obtained are stated to be very encouraging and leading to increased production of mohair. Field programmes to take up production of mohair by crossing hairy breeds with Angora in cold arid areas should now be initiated.

7.3.27 An analysis of the trend of goat population over the period 1951 to 1972 has shown an enormous progressive increase in the number of goats. While the goat population in 1951 was 47 million, it was as high as 68 million in 1972. This can produce a devastating effect on vegetation due to browsing habits of goats. The sheep and goat owners should, therefore, be educated on the

advisability of reducing the number of goats and improving their quality. Further, restrictions on grazing of goats on specially developed grasslands should be imposed. At the present rate of growth, the number of goats is likely to be of the order of 70, 74, 78 and 90 million in 1975, 1980, 1985 and 2000 respectively. It may not be possible to arrest their number in the normal course up to 1980. But the slaughter of goats for meat purposes should be increased so that the population of goats may come down to a level of 67 million by 1985 and get stabilised at about 40 million by 2000 AD.

4 POULTRY

7.4.1 Poultry farming is possible in widely differing agroclimatic environment and provides an excellent opportunity for gainful employment to idle or underemployed members of rural families. As a result of organised and concerted efforts made under poultry development plans on a countrywide scale, a firm base has been laid and poultry farming has established itself in India as a profitable commercial enterprise.

Poultry Statistics

7.4.2 With a view to collecting more useful reliable information for the purpose of preparing effective and realistic poultry development plans steps should be taken for obtaining sexwise classification of poultry population and breedwise breakdown of improved fowls during livestock censuses. Research should be continued and expanded for development of methodology to obtain reliable information on all aspects of poultry farm economics.

Development of Poultry Farming

7.4.3 Under the First Plan, an All India Poultry Development Programme aiming at establishment of Poultry Extension-cum-Demonstration Centres was launched. The scope of the programme was enlarged during the Second Plan by establishing five Regional Central Government Poultry Farms. These centres, each with 100 layers of improved breeds, were set up to demonstrate the modern methods of poultry keeping, impart training in poultry raising, supply infrastructural facilities and provide custom hatching facilities. The concept of backyard poultry keeping in the sixties yielded place to poultry farming as a commercial enterprise. Initiation of an Intensive

Egg and Poultry Production-cum-Marketing Project (IPDP), with an area development and package approach, was the most important factor for bringing about a favourable development. Under this project, centres were established in selected urban areas in different States. Scientific poultry breeding programmes were launched and Central poultry farms were set up as a first step towards attaining selfsufficiency in the production and supply of high quality chicks. During the Fourth Plan, a high level Inservice Training Institute was established at Hessarghatta. The selective breeding programme initiated earlier at the Central poultry farms was modified and a Coordinated Poultry Breeding Project (CPBP) was launched in which three Central and a number of selected State poultry breeding farms participated. The IPDP was further enlarged. Poultry disease control measures and disease diagnostic services were strengthened and mobile veterinary clinics were established. During this period the Central Government launched a special project (CFDA/MFAL) in which poultry development formed an important component.

7.4.4 The target of egg production in 1978-79 has been fixed at 11,583.4 million by the Planning Commission. Keeping in view the likely trend in the growth of income, income elasticity of demand and growth of human population, the aggregate consumer demand is expected to rise to 10,217 million eggs and 15,972 million eggs in 1985 for low and high demand respectively. The aggregate consumer demand in 2000 AD will range between 17,419 and 28,513 million eggs on the two assumptions of growth in per capita private consumption expenditure referred to in Chapter 3. Besides production of eggs, poultry farming has to strive for broiler production. The number of broilers expected to be produced in 1985 is 17.2 million and this would go up to 71.8 million at the end of the century. For attainment of higher production from poultry the development programmes must include a sound and effective poultry breeding strategy for developing strains of chicken genetically capable of higher egg and meat production.

Breeding

7.4.5 The foundation of commercial poultry production based on scientific breeding can be said to have been laid in India in the sixties when some enthusiastic private entrepreneurs established franchise hatcheries of foreign based poultry breeding organisations for commercial mass production of genetically superior hybrid chicks, claimed to have potentialities of laying 230-250 eggs a year. As a result of this enterprise, superior quality hybrid chicks with excellent

egg laying potentiality became available in the country in large numbers. Because of increasing demands for high egg producing hybrid chicks, the franchise hatcheries disseminated the superior stock through their associate hatcheries set up in different parts of the country. These ventures were useful for immediate growth of poultry farming, though, in the long run, these are not conducive to the growth of the industry.

7.4.6 The franchise hatcheries and their associates are at present merely functioning as multiplication centres for producing hybrid chicks out of parent/grandparent stock supplied by the foreign based breeding organisations. The basic genetic material (pureline stock), however, is entirely in the hands of the breeding organisations abroad and remains an exclusive preserve of the principals of the franchise hatcheries. The terms of agreement for operation of the franchise hatcheries in the country are such they are completely dependent on their principals, and are required to import periodically grandparent/parent stock for production of commercial chicks. Such agreements involve foreign exchange commitment on a continuous basis. Moreover, it is not in country's interest to have this flourishing industry so dependent on foreign agencies for supply of source material for its very existence. Due to changed political relations, foreign trade policies, international monetary position, transport restrictions, tariffs, etc., there may be long interruptions or complete stoppage of supply of grandparent/parent stock of hybrid chicks. Such an eventuality would be ruinous for the poultry industry that has developed only recently, and is still growing fast in the country.

7.4.7 It is satisfying to note that the Central Government has decided not to allow any new collaboration project with foreign organisations for establishment of franchise hatcheries. Three poultry breeding organisations have been established in the private sector with agreements for supply of original breeding lines from foreign based breeding farms in place of supply of parent/grandparent stock. The stock for these breeding farms have come from three sources, viz., USA, Czechoslovakia and Israel. The existing hatcheries are also being advised to persuade their principals to supply pureline stock in preference to parent and grandparent stocks.

7.4.8 As a further step towards attaining self-sufficiency in the matter of supply of high quality commercial hybrid chicks, the Central Government has rightly taken a decision to put a ban on importation of exotic stock for commercial production of hybrid chicks. Import of exotic stock of poultry will, however, be permitted for research and development work on the recommendation of the Standing Committee on Poultry Development. This decision is in

the right direction. It should, however, be ensured that production of high quality commercial hybrid chicks is obtained in adequate numbers out of stocks developed indigenously. The hatcheries producing the chicks must also have efficient organisation to maintain or improve upon the high standard reached. A premature ban on importation of exotic stock with consequent fall of standard in the quality of commercial hybrid chicks may cause serious set back to the developing poultry industry.

7.4.9 Production of hybrid chicks out of stock developed in the country is all the more necessary as the basic stock developed by the foreignbased breeding organisations are always bred and maintained under much superior management conditions. A high nutritional status of the basic stock cannot be ensured economically in the country because of acute shortage and the consequent high prices of the requisite inputs, like poultry feed ingredients. Consequently, the hybrid chicks produced from those basic stock may not be as adaptive to a poor environment. There is a view among eminent geneticists that greater benefits may be derived if the breeding stock is reared in the environment where their progenies are going to perform. There are distinct possibilities of developing strains more favourably adapted to the ecological niches prevailing in the country. Urgent measures are, therefore, imperative for taking up large scale poultry breeding programmes for development of such stock.

7.4.10 The breeding programmes, undertaken in the Central and State poultry farms, have yielded some promising results. At least five different strains of White Leghorn, two different strains of Australorps and one strain of Rhode Island Red have been identified as being suitable to form the foundation stock for carrying out selective breeding programmes on an extended basis.

7.4.11 The initial attempts based on sire family selection programme made by the Central and State farms in the sixties to develop high egg laying strains of chicken yielded some encouraging results. However, it was found that the coordination between the Central and State farms was not satisfactory, and that the breeding programmes needed enlargement in size and uninterrupted pursuit in a sustained manner. Further, a modification of the technical programme was considered necessary to achieve the desired goal of production of high yielding stocks expeditiously. A revised technical programme was, therefore, drawn up in the early seventies for launching a Coordinated Poultry Breeding Project (CPBP) by the Government of India.

7.4.12 The operation of the CPBP over the last few years has revealed the possibilities of creditable achievements, but it is necessary

to take effective steps for removing the constraints that are now standing in the way of proper implementation of the Project on a big enough scale. The most serious shortcomings relate to the lack of adequate facilities in several of the participating State farms as also to some extent in the Central poultry breeding farms. If the required physical facilities and properly trained personnel in adequate numbers cannot be provided in a poultry farm, it would be a complete waste of time and money to incorporate that farm as a participating unit. The persons incharge of important breeding projects should not be transferred during the tenure of the projects to provide continuity in management.

7.4.13 Considering the limitations of resources and the difficulties that come in the way of the State Governments in providing adequate funding facilities and technical expertise, it would be desirable to make a fresh reappraisal of the CPBP and consider some basic changes for funding the scheme and also define clearly the areas of work that may be undertaken by the respective Central farms and the other participating State poultry farms. The most satisfactory arrangement would be to remodel the present Project as a Centrally sponsored National Coordinated Poultry Breeding Project (NCPBP) so that the expenses relating to the execution of the programme in the participating State poultry farms are borne partly or wholly from the Project. The Central Poultry Breeding Farm at Hessarghatta should serve as the Central unit of the proposed NCPBP and the officer-in-charge of the farm at Hessarghatta should function as the Project Coordinator.

7.4.14 As regards the participating State poultry farms, instead of spreading out the work of the NCPBP in a number of State farms with inadequate facilities, it would be more profitable to keep the activities concentrated in a limited number of farms where the availability of necessary inputs and services are assured. For the selection of State poultry farms for participation in the proposed NCPBP for strain development work, a fresh examination and reappraisal of the poultry farms in the country by technical experts will be required, as also fresh negotiations with the concerned authorities.

7.4.15 Apart from the State poultry farms selected for strain development work, another group of State poultry farms with suitable facilities could be utilised for largescale testing and multiplicaion of the strains developed in the three Central poultry farms and the selected strain-developing State farms. The Central poultry farms should demarcate the participating strain-developing State farms and also the State farms for large scale testing into three regional groups. Each region should be assigned to a particular Central farm for exe-

cution of the breeding and testing programmes. The strains to be developed and the progenies to be tested for production performance should be sent from the Central poultry farms to the State farms in their respective regions. Such a step in testing the strains would help in developing stocks for general adaptability over a wide range of environmental conditions.

7.4.16 Among the various developmental activities undertaken for promotion of poultry industry, the breeding programmes initiated by the Central Government and the ICAR have great importance as the success or failure of these projects would greatly determine the future of the poultry industry in the country. Scientific poultry breeding programmes for development of strains for production of hybrid chicks were first undertaken at the Central poultry breeding farms and under the projects sponsored by the ICAR about a decade ago. Certain deficiencies in the operation of these projects were noticed and these were sought to be removed. Inspite of these steps the progress in the implementation of the programmes of both the Central Government and the ICAR projects is much slower than what was envisaged at the time the revised programmes were formulated. The All India Coordinated Research Projects (AICRP) of the ICAR do not suffer from the difficulty that has been encountered in the CPBP of the Central Government in the availability of funds for developing the required facilities in the participating farms. Though the objectives of the Central Government and the ICAR projects converge in the matter of development of strains for egg production, these two projects are working almost in isolation. As the objectives of both the projects are egg production, much would be gained by coordinated collaborative work between the two projects. A committee of experts has recently been constituted for proper coordination of work now under progress in the CPBP and the ICAR projects. There is considerable merit in simultaneous operation of two separate coordinated breeding programmes, one by the Union Ministry of Agriculture and Irrigation in collaboration with State poultry farms and the other by the ICAR because there is no sure-shot breeding technique for achieving the objectives. Simultaneous operation of the two coordinated projects gives greater promise for achievement of success. However, this can be realised if the projects function in close collaboration in a complementary manner. Stocks can be exchanged, experiences can be shared, joint discussions can be had and views exchanged in periodically arranged seminars and workshops. As the Central Government poultry complex at Hessarghatta has the facilities for random sample tests (RST) as also data analysis equipment, all the performance tests of the developed strains

should be conducted there. It would be of advantage to have much of the work of data analysis of both the projects carried out at Hessarghatta.

7.4.17 Breeding experiments conducted by the IVRI in the forties and fifties, had established that *desi* fowls had potentialities for higher egg production. The investigations on *desi* poultry, however, were not continued mainly because there were no prospects of the research findings being utilised for poultry production at that time. As poultry industry developed subsequently, interest was revived in studies on *desi* fowls and in the mid sixties two large scale research projects were initiated at the agricultural universities at Hissar and Udaipur, supported with finances from the PL 480 funds, to evaluate native fowl germplasm resources and the performance of crosses between the native fowl and the exotic breeds. In some of the studies made under these projects, the *desi* or its crosses with exotic breeds were found to be superior to pure exotic stock in respect of production performance, livability and disease resistance, when those were maintained under a high standard of management.

7.4.18 The indigenous fowl resources have not found any significant place so far in the poultry breeding programmes for the production of hybrid commercial chicks in the country. But it may become necessary in future to incorporate some of the desirable characteristics of *desi* fowl in the commercial breeding stock. Considering the importance of this matter, a programme should be initiated by the ICAR to collect and preserve native fowl germplasm resources.

7.4.19 Identification and development of strains is a continuous process and there should be unceasing efforts to locate and maintain high producing strains within the country and to import purebred, disease-free strains when suitable ones are available. In the past, several good strains imported from abroad lost their identity due to improper management and negligence in the maintenance of proper records. Preservation and improvement of germplasm are important for supporting a prosperous poultry industry. Central Germplasm Banks in different agroclimatic regions should be created, where large populations of the distinctly identified strains/lines will be maintained under high standard of management to avoid deterioration in their performance.

7.4.20 Efforts should also be made to synthesise new genetic material at regular intervals by pooling the various stocks available in the country for development of random bred control populations. These control populations will form a base material both for carrying out breeding research and for differentiating the genetic trend from

the environmental trend and, thus, serve a dual purpose.

7.4.21 For proper maintenance and efficient management of the Central Germplasm Banks, these should be placed under the control of a high level Standing Committee on Poultry Development (SCPD) established by the Union Ministry of Agriculture and Irrigation and charged with the responsibility of looking after various poultry development activities in the country. The Committee of Experts formed for coordination of work of the CPBP and the ICAR poultry breeding projects may be transferred to the Standing Committee with wider representation. For making the change effective, the Committee of Experts should be enlarged to include representatives from the agricultural universities, State Governments and All India Poultry Industries' Association.

7.4.22 In India, random sample egg laying test was first started in 1963 at the IVRI but it was discontinued in 1971. A separate unit for RST was, however, established at Hessarghatta, Bangalore in 1969 under the direct administrative and technical control of the Union Ministry of Agriculture and Irrigation. At present, for the egg laying test being carried out at Hessarghatta, a sample size of 45 is being used. Sample size and measures for controlling the environmental variations are directly related to the accuracy of results. The test sample size should be increased to at least 60 pullets per entry per test centre to attain greater accuracy in RSTs for egg laying. RSTs should be conducted under the control of the SCPD to generate confidence among the participants.

7.4.23 Till the stage of compulsory testing is reached, some action should be taken to avoid any setback to the progress made in poultry development. As a first step, all the hatcheries selling chicken for commercial purposes may be licensed. The hatcheries should also be required to give extensive field trials before any commercial strain is released for general sale. The reliability of performance of the stock claimed by the breeder or a farm and the advisability of releasing a stock developed for commercial use should be decided by the SCPD.

7.4.24 Chicksexing training courses should be organised on a regular basis. To ensure high quality of training, it may be desirable to send a few suitably qualified persons abroad for advanced training. Persons trained in chicksexing should appear in an examination every three years for recertification of their competence. Steps should be taken to incorporate autosexing genes in the stocks being developed under the Central Government and the ICAR poultry breeding projects.

7.4.25 Broiler production programmes should be taken up

around all the seventeen poultry dressing plants on a priority basis. Around each of the fifteen 1,000 bird dressing plants located in or near the Intensive Poultry Development Project (IPDP) Centres, a poultry farmers' cooperative with hundred members should be formed. The broiler production programme should be so arranged as to enable two members to supply one day's full requirement for the plant. The broiler dressing should be undertaken for 200 days of a year, whereas for 100 days dressing and processing of culled hens from egg producers should be undertaken in these plants. The IVRI and the Central Food Technological Research Institute (CFTRI) should attempt at evolving a cheap process of cooking and packing of meat from hens that are sold as table birds after the laying period. The process evolved should be easily operable even under rural conditions.

7.4.26 High producing straincross or incross hybrid chicks should be reared in places where high standard of poultry husbandry exists. Where poultry husbandry has not attained a high standard, but is at the intermediate level, exotic breedcross chicks should be raised. For backyard poultry keeping in rural areas, crossbred cocks obtained either by crossing White Leghorn in males and Rhode Island Red females, or White Leghorn males and Australorp females, should be used for grading up the indigenous stock.

7.4.27 Poultry estates should be established in selected localities in different States and Union Territories for providing employment to the educated unemployed and for rehabilitation of the physically handicapped.

7.4.28 Agricultural universities in orchard growing States should undertake studies on the economics of poultry keeping in orchards and determine the optimal conditions of poultry raising under this system.

7.4.29 Poultry production through SFDA/MFAL projects should be organised following the recommendations made in the Interim Report on Poultry, Sheep and Pig Production through Small and Marginal Farmers and Agricultural Labourers for Supplementing their Income. Every effort should be made to implement the programme in all the 167 districts identified for this purpose at least by 1985, if not earlier.

Poultry Feeds

7.4.30 The future growth of poultry industry largely depends on the availability of balanced feeds at reasonable prices. Attempts should be made to procure ingredients of poultry feeds at reasonable cost and to use industrial byproducts in greater measure till the stage

is reached by 2000 AD when there should not be any shortage of grains for poultry feeding. Extensive studies should be undertaken for greater use of agroindustrial byproducts in poultry feeds. Investigations on least cost formulation of balanced poultry feeds should be undertaken on extensive scale.

Health Cover

7.4.31 Early action should be taken to introduce licensing of commercial hatcheries under suitable legislation in consideration of disease hazards. The licences should be granted only by the Central Government on the recommendation of the SCPD.

Credit, Cooperatives and Marketing

7.4.32 Easy flow of credit to farmers, cooperatives and other organisations is essential for the sustenance and growth of the poultry industry. Procedures need to be simplified to ensure the flow of credit to the relatively poor sections of the farming community. Action should be taken to enable landless labourers and small and marginal farmers to obtain loans on personal surety expeditiously but it should be ensured that the loans are given only to *bonafide* farmers and landless labourers. Multitiered structure of poultry farmers' cooperatives should be organised on the lines recommended in the Interim Report on Poultry, Sheep and Pig Production. Market survey studies should be taken up at regular intervals to collect information on the factors influencing the pricing of eggs and other poultry products. Extensive research on processing and packaging of poultry products should also be taken up early for promotion of poultry industry.

7.4.33 All the four proposed Regional Cooperative Marketing Federations of the National Egg and Poultry Products Marketing Federation should be fully equipped for quick disposal of eggs. This organisation may enter into agreements with milk drying plants to manufacture egg powder. The State Animal Husbandry Departments should launch a massive drive to educate poultry farmers in producing clean and infertile eggs and their hygiene handling.

7.4.34 Preliminary work relating to the establishment of the National Egg and Poultry Products Marketing Federation should be completed expeditiously. State Marketing Federations should be set up quickly where these do not exist. As a practical solution to the prevailing problem of marketing of eggs during summer, the egg

production programme may be modified both in the rural and urban areas.

Duck Rearing

7.4.35 Besides being a profitable source of egg and meat production, the raising of ducks may lead to several incidental benefits. Next to fowls, ducks are the most important egg producing birds in India. Research studies should be undertaken to find out if the peculiar odour problem of duck eggs could be eliminated through alterations in the management and dietary of the birds, or by chemical treatment of eggs. Systematic research investigations should soon be initiated on various aspects of duck husbandry in the States, where ducks constitute an important species of poultry. Initially, the ICAR should sponsor such research projects. Subsequently, the agricultural universities of concerned States may pursue studies on different problems of duck husbandry.

7.4.36 To develop the expertise required for operation of large size duck farms with superior quality exotic ducks, systematic studies should be undertaken on different aspects of duck husbandry in the proposed Central Duck Breeding Farm. Some international agencies should be approached for making expertise available for building up duck farming in the country on modern scientific lines.

Research and Education

7.4.37 While there is urgent need to create a sound research base for the poultry industry, this base must have a strong foundation in a well conceived plan of education in poultry science. A number of preuniversity level poultry training programmes are at present being pursued by various teaching institutions in India. Some of these training courses are serving a useful purpose by fulfilling local needs. At the same time, the quality and standard of training in some of the courses are so poor that they should better be discontinued. At the Bachelors degree level, all the education in poultry science that a student can obtain at present is what he gets as a very small part of Bachelor's degree course in Veterinary Science and Animal Husbandry or a degree course in agriculture. This is far too inadequate for properly training the persons who would be required for manning the specialised branches of poultry industry. Agricultural universities in the States, particularly where poultry constitutes an important part of agroindustries, should have separate Poultry Science Departments. Further, a National Avian Research Institute

dealing with all species by poultry and allied subjects should be established to give research support to poultry industry.

5 OTHER LIVESTOCK (PIG, EQUINES, CAMEL AND YAK)

Pig

7.5.1 In India, pig farming has a special significance as it can play an important role in improving the socio-economic status of a sizable section of the weaker rural community. It remained neglected for long because of a general apathy against this occupation. Furthermore, many constraints, like insufficient availability of high quality stock, balanced feeds at economic prices and absence of favourable market conditions, hampered pig production.

7.5.2 At present the only source of pig population statistics is the quinquennial Livestock Census. For formulating effective pig developmental programmes for different areas, it is necessary to have information on regional changes in the size and composition of population in terms of indigenous, crossbred and exotic stock from time to time. To meet this requirement, the IARS should develop proper sample survey techniques for obtaining dependable population estimates during Intercensus periods. Immediate steps should also be taken so that during the future Livestock Censuses information is collected at least on the types of pigs, like indigenous and improved, and on broad age classification of adult and the youngstock on a sample basis, during the livestock census.

7.5.3 Available data on economics of pig farming in India are at present very scanty. Information on this aspect is equally important for realistic planning. The IARS had, sometime ago, made some pilot studies on the economics of milk production in the country under different husbandry practices. The Institute should undertake, on a priority basis, similar research investigations on the economics of pig production.

7.5.4 Piggery development work is seriously handicapped by almost a total lack of production and consumption statistics. The information on production and consumption of pork and pork products is at present entirely dependent on *ad hoc* surveys. For determining the demand consumption and supply of pork and pork products surveys should be conducted at regular intervals by following proper statistical techniques. All the cities and big towns, where pigs are slaughtered regularly, should have arrangements for licensing

of pig slaughtering. The slaughter houses should maintain proper records on the number of pigs slaughtered, live weight, dressing percentage etc. Suitable sampling techniques should be evolved by the IARS to find out the number of pigs slaughtered in rural areas, and a suitable cell should be created in the Directorate of Marketing and Inspection (DMI) for conducting regular periodic surveys on live-stock and livestock products.

7.5.5 Establishment of eight bacon factories during the Second and Third Plan periods was the beginning of an attempt made for making wholesome pork and pork products available to the consumer. However, none of the bacon factories is working even at fifty per cent of the installed capacity at present. Necessary steps should immediately be taken to remove constraints in the way of taking up appropriate breeding programmes in the Regional Pig Breeding Stations attached to bacon factories, pig breeding farms and units surrounding the factories to ensure steady supply of quality pigs. Further, the bacon factories should adopt such pricing policies as would encourage the farmer to take to pig rearing. These factories are put to disadvantage when they are in competition with the private sector enterprises. As there is no system of quality control and no ban on clandestine slaughter, the private sector enterprises are free to use substandard material and processes. This naturally reduces the cost of inputs for private sector enterprises and as such they always have an edge over the public sector enterprises. The private sector enterprises should be induced to buy the raw material from licensed pig slaughter houses and the system of quality control should be enforced rigidly. The bacon factories should also take necessary steps to popularise their products and undertake consumer education programme. Pig population in the country consists mainly of indigenous nondescript types. For improving the production performance of *desi* stock to anywhere near that of exotic ones without introducing any exotic inheritance would be an impossible task within a limited period of time and reasonable investment. This is so because the heritability of reproductive traits is not high and those for the traits like body weight gain and feed conversion efficiency are only moderate. The Central Government has rightly adopted the policy of breeding superior quality breeds of pigs in the Regional Pig Breeding Stations and the other pig breeding farms/units. The policy of grading up the indigenous stock by using males of improved exotic stock is also sound and suitable under the prevailing conditions.

7.5.6 The Regional Pig Breeding Stations are expected to take up selective breeding programme with the objective of acclimatisation

and further improvement of the imported exotic stock. Regional Stations would supply breeding stock to the breeding farms/units and those in turn would undertake the task of grading up the indigenous stock. It is disappointing to note that even after several years of establishment of Regional Pig Breeding Stations, no methodical selective breeding programme has been taken up. It has been reported that several inadequacies, like lack of farrowing pens and shortage of housing facilities, unsatisfactory feed compounding and watering arrangements, shortage of suitably trained personnel, and insufficient herd strength for carrying out any effective selection programme, were the main reasons for the failure to achieve the objectives.

7.5.7 For achieving success in developing high production stock, maintenance of a minimum effective breeding population is necessary. The nucleus breeding population size should be 200 sows and 20 boars to avoid inbreeding and to have reasonable degree of selection intensity. A comprehensive coordinated breeding programme should be drawn up for all the seven Regional Stations. Simultaneously, a well drawn out programme of production of commercial pigs should be taken up so that the genetic improvement of the herd, as also supply of pigs to the bacon factories, can be accomplished. Exotic bacon producing breeds, like Large and Middle White Yorkshire and Landrace, appear to have adapted well to the agroclimatic conditions of the country and are preferred by the farmers. In some parts of the eastern region of the country, however, people have a preference for black coloured pigs. So, a suitable breed like Berkshire, Hampshire Saddleback or Poland Chine should be the choice for these areas.

7.5.8 It would be advisable to give trials to the AI method of breeding in order to determine how it would pan out under Indian conditions. If found practicable, it should be adopted in important pig breeding stations. As the equipment for AI in pigs is not manufactured at present in India, local manufacturers of AI kits should be encouraged to fabricate the kit by providing them with necessary samples and designs.

7.5.9 There is a strong need for adopting a coordinated breeding programme in all the Regional Pig Breeding Stations in order to exchange breeding stock and ideas, and to discuss and evaluate the progress of the programme. For this purpose, the officers-in-charge of the stations should meet, say, once a year. A coordinating cell should be formed and the officer-in-charge of each breeding station may act as coordinator by turn for a period of one year.

7.5.10 The ICAR initiated an All India Coordinated Research Project on Pigs during the Fourth Five Year Plan. Its major objective is to develop suitable breed or breeds using imported stock. It is reported that the technical programme as was drawn up, has not been followed in any of the centres. However, the performance of Landrace at Assam Agricultural University, Khanapara and Izatnagar, and of Large White Yorkshire at Tirupathi and Jabalpur procured from within the country, are being evaluated. The objective of such a project should be the evaluation of the performance of different breeds and breed combinations under different agroclimatic environments prevailing in the country so that the most suitable breeds for different locations could be selected. If any useful results are to be achieved from the ICAR project, the present working programme should be suitably modified and herd strength enlarged. Adequate funds should be provided to create necessary infrastructure in all the participating centres, without which it will not be possible to implement any meaningful technical programme, and any attempt to develop suitable breed would be sheer wastage of money and manpower. Necessary arrangements should be made early to import superior germplasm resources for the foundation stock for this Project.

7.5.11 Where the better type of indigenous stock is available, the agricultural university of the area should take up breeding work on pure indigenous stock and should also investigate about the appropriate exotic breed to be used for the grading up of the indigenous stock. Investigations should be undertaken to determine differential response, if any, of improved, exotic, graded and indigenous stock to climatic and nutritional factors and disease resistance.

7.5.12 In the Interim Report on Poultry, Sheep and Pig Production referred to earlier pig production programmes have been recommended in 100 selected districts. For successful implementation of the proposed crossbreeding programme, a large number of boars of exotic breed will be needed. Each State Department of Animal Husbandry should strengthen the infrastructure of their farms for meeting the demand of the breeding stock, specially in the areas where the SFDA/ MFAL programmes involving piggery development have been taken up.

7.5.13 Pig development has a special significance in the north eastern hilly regions. The Central Government is taking up a very comprehensive piggery development programme for the north eastern states with the help of Danish International Developmental Agency. The scheme should be implemented expeditiously.

7.5.14 The major expense in commercial pig production is the feed cost, and it accounts for 70 to 80 per cent of the total cost of

pig production. Intensive researches in pig ration should, therefore, be undertaken at the IVRI and in agricultural universities, for identifying low cost ingredients for replacement of grain in pig ration, and on the nutritional requirements of various classes of pigs.

7.5.15 Inter and intrabreed differences exist in their efficiencies of feed conversion. There is also variation among pigs in the amount of lean meat produced per unit of feed consumption. As development of pigs with high efficiency in feed conversion through careful selective breeding is of great significance in pig production such breeding programmes should be initiated as soon as possible. Another fruitful area of research that should be developed relates to the effect of restricted feeding and of different feeding practices on meat production. Restriction of feeding can either be done by restricting the energy content of feed or by limiting the total quantity of feed intake or limiting the time of feeding. Various feeding practices may markedly influence carcass composition. Different breeds, strains or other genetic groups like sire family within a strain or a breed may behave differentially on different types of feeding practices and/or nutritional standards. This area of research, if developed properly, can effectively be exploited for reducing the cost of feeding and also for increasing the output of lean meat. Such studies should be the joint responsibility of pig nutritionists and geneticists. Researches on the above lines should be initiated by the IVRI and agricultural universities for long range benefit of pig production in the country.

7.5.16 Unlike indigenous pigs, the raising of exotic or crossbred pigs is possible only under proper housing and sanitary conditions. Improved pigs require well ventilated and well lighted pens fitted with watering arrangements and feed troughs. There is particularly a need for having separate farrowing pens for pig rearing on modern lines. Hardly any work has been done in India to fabricate cheap pig houses. Studies should be undertaken on designing and construction of suitable cheap houses for pig farming using locally available materials.

7.5.17 Credit facilities available at present from institutional sources for pig farming are inadequate and unsatisfactory. The traditional pig farmers are mostly at the mercy of local money lenders. Necessary steps should be taken to make institutional credit facilities available to the pig farmers to save them from ruthless exploitation by village money lenders. The best way to develop pig industry is to provide an incentive price to the primary producers by organising them on cooperative lines.

7.5.18 There is a general prejudice against eating of pork. To remove resistance against pig meat, sufficient promotional activities

to popularise consumption of pork and pork products is essential. Some of the important steps that should be taken for this purpose are as follows :

- (i) establishment of modern meat booths at different places and extensive as well as intensive publicity and propaganda regarding the value of high quality protein-rich pork and pork products;
- (ii) banning of pig rearing in metropolitan areas;
- (iii) encouragement to school and college canteens for selling pork products in the form of hamburgers, hot dogs, pork chops etc. at subsidised rates;
- (iv) encouragement to the bacon factories to diversify the range of their products and make such articles as small-cut chops, keemas, pork chops etc. that can be used in place of mutton. This will reduce pressure on the demand for mutton and assist consumers in getting equivalent meat products at lower prices;
- (v) encouragement to bacon factories to develop their own chain of retail shops with cold storage equipment for sale of fresh pork and pork products;
- (vi) initiation of measures by the urban consumer societies to popularise consumption of pork and pork products;
- (vii) active publicity by the Central/State Governments for consumption of pork and pork products through cinemas, pamphlets and leaflets etc. in regional languages; and
- (viii) introduction of applied nutrition programme in tribal and backward areas.

7.5.19 Private pork industry makes no attempt to promote pork production by extending inputs and services to pig farmers. The lower price paid on the basis of live weight is not conducive for the production of superior quality pigs. Consequently, indigenous pigs, reared under traditional methods, are purchased at low prices and used for processing. Many of these private establishments have arrangements for buying carcasses of clandestinely slaughtered pigs or from unauthorised slaughter houses as these give them a much greater margin of profit. Thus, the private pork industry by selling the substandard pork obtained from indigenous pigs has posed a problem to those who obtain pork from exotic pigs maintained under farm conditions. To prevent the private bacon factories buying carcasses through unauthorised sources the Meat Food Products Order, 1973 should be rigidly enforced.

7.5.20 A standard of quality control of the processed pork and pork products should be laid down and should be strictly followed. The
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CFTRI has excellent facilities for research on processing and packaging of meat and meat products. The Institute should extend research studies on processing and packaging of pork and pork products to evolve necessary techniques for manufacture of these products under Indian conditions to match the international standards. Action is also necessary to have standards formulated for these products for eligibility for 'Agmark' certificate.

7.5.21 Pig production is relatively a new venture in the country. If an aggressive pig production programme is to be supported with trained personnel, it would be necessary to organise suitable training programmes. Training programmes should be organised on a three-tier basis, namely, for the field staff concerned with extension work, for the stock assistants and pig farmers and for the butchers and processors. For the qualified technical staff, it would be desirable to organise programme periodically either at the national or at the regional level. One of the pig breeding station-cum-bacon factories should be developed into an Inservice Training Centre. The training of stock assistants and farmers can be organised at each station. The training for butchers and processors should be organised in the pig slaughter houses and processing plants themselves.

Equines

7.5.22 The broad conclusion that can be drawn from the livestock census data with a reasonable degree of accuracy is that beginning from 1951, there has been a continuous decline in the equine population in the country, and that the decrease in the population of horses and ponies has been more pronounced than that in other species of equines. At present, only data on the number of horses and ponies classified age-wise into those under 3 years and those above are available. Mules and donkeys are enumerated without any classification by age or sex. So as to make the census data on equines more meaningful for the purpose of planning for development, the Union Ministry of Agriculture and Irrigation should immediately constitute a committee to advise on the scope and content of the future livestock census.

7.5.23 Realistic and effective planning for equine development is more difficult than for other livestock. Smallness of the size of population, widely scattered distribution of the stock with absence of concentration within a limited area, absence of breed or type descriptions, paucity of good specimens, nonexistence of easily measurable, commonly accepted standards for assessment of the quality of the stock, poor financial resources of vast majority of stock owners, total absence of organisation except for a very small section of horse owners are problems which render the efficient planning extremely difficult. Moreover,

in planning for equine development this has to be kept constantly in view that with time, progressive decline in the utility and use of equines is inevitable, except for the horse for which there is likely to be an increasing demand for superior quality animals for games and sports. Planning for equine development has, therefore, to be phased in a manner that should fit in with the probable changing trends.

7.5.24 Along with the steps that may be taken for stock development, several other steps are required to vitalise the trade of equine transportation to benefit the traders. Development work in this sphere should be developed on lines somewhat similar to the ICDP or IPDP in carefully selected areas. As in the case of cattle and poultry development projects, equine development project should have the necessary inputs and services made available in a package for its success. For preparing the blueprint of equine development projects and for selecting the areas where such projects should be undertaken, socioeconomic studies are essential. The ICAR should immediately sponsor such research studies to be undertaken in agricultural universities of selected States. On the basis of these studies, suitable development programmes should be formulated for different selected locations.

7.5.25 Equine transportation will continue in future to remain useful generally in tracts with poor road development. Since such areas lie mostly in the lesser developed States, projects for equine development aiming at providing assistance to the weaker section of people engaged in equine transportation trade may have to be supported fully or largely by the Central Government by way of finance and technical guidance. The Central Government should accept this liability as its contribution towards social justice and for removing regional imbalances.

7.5.26 Of the equestrian sports, the one most flourishing is that of horse racing. It would be in national interest for the Government to take full control of horse racing in the country. Such a step can put the sport of horse racing on a clean and healthy footing, and it would be possible to utilize the sport, as is done in several countries, for promoting equine wealth for the benefit of the nation.

7.5.27 A fresh review of the entire field of horse racing and race horse breeding industry in India is necessary. The Union Ministry of Agriculture and Irrigation should convene a meeting of all interests and specialists concerned with the import, breeding, racing and training of horses in India. The impact of taxes and other charges levied on the breeders of horses and turf clubs should also be reviewed by this Committee so that the taxation policy can be rationalised. The ways by which the horse race industry can contribute towards the promotion of equine industry in general within the country should also be considered at this meeting.

7.5.28 For the present, blood stock breeding of race horses may be left in private hands. But urgent action is called for more effective control on various alleged undesirable practices,, like breeding of horses in insufficient numbers, charging of inordinately high stud fees, importation of horses in irregular manner etc. In order to exercise control on racing and all organised equine breeding, including that of race horses, and for promotion of national equine development programmes for improving the equine wealth of the country, the Union Ministry of Agriculture and Irrigation should establish a high powered Equine Development Board (EDB) as early as possible.

7.5.29 As an immediate measure to control breeding of race horses, steps should be taken to register all private studs with the Equine Development Board. No new private race horse breeding stud should be allowed without the sanction of the EDB. Before granting permission, the EDB should ensure by inspection that necessary land for housing and for growing fodder, and stables conforming to normal standard and proper knowhow of horse management, are available. The stud farm should be inspected every year to ensure that only licensed stallions are used, and that the stables etc. conform to reasonable standards of sanitation and other requirements.

7.5.30 High quality race horses are very expensive animals. It is, therefore, necessary for the breeders in India to take steps to maximise the utilisation of imported and other high quality horses. For this purpose, the breeding charges levied by the studs should be reviewed and, if found necessary, the charges should be revised.

7.5.31 The wastage of race horses due to leg injuries and other causes is considerable. The rate of reproduction is low. Improvement in rate of reproduction should be possible with better veterinary care and management of the mares during pregnancy and at foaling. A drain on horses due to defects in legs can be reduced by having better qualified trainers, and by improving the racing tracks.

7.5.32 Various promotional activities are undertaken by the Central and State Governments and private organisations for different games and sports. Similar activities may be undertaken for the promotion of equestrian sports. The proposed EDB, the Turf and Gymkhana Clubs, the army and police organisations, Animal Husbandry Departments of the Central and State Governments as also the Department of Sports existing in some of the States can do a great deal to cultivate interest in equestrian games and sports without incurring a great deal of expenditure. There were some practices followed in the past that promoted interest in equestrian sports. In many veterinary colleges horse riding was encouraged and trainers were retained for giving lessons in equestrianism. In some colleges riding was compulsory. Horse shoeing con-

stituted a compulsory subject. In police training, riding was a compulsory requirement. Those were very desirable practices and consideration may be given for revival of these practices.

7.5.33 *Bhutia* ponies are found in the large hilly and submontane tracts of the Himalayan ranges. In these areas equine transportation is of considerable importance and, in some places, this is the only mode of transportation. Such a situation is likely to continue for a long time in future. *Bhutia* ponies have proved themselves eminently suitable for work on such terrains. There is, thus, a definite need and adequate justification to preserve and improve this breed to meet present requirements and also future needs. *Marwari* and *Kathiawari* as also *Manipuri* breeds have qualities to make good riding horses. *Manipur* has the additional advantage of being surefooted on hilly terrain that make the animals of this breed suitable for work in mountainous regions. Being indigenous breeds, all these animals are well adapted to the local agroclimatic environments.

7.5.35 With proper organisation, it should be possible to establish a horse breeding industry in the civilian sector that would make it independent of the military establishments for obtaining supply of horses. During emergencies, the military establishments may not be in a position to meet the civilian needs for horses. Moreover, the existence of an efficient horse breeding civilian organisation may be of advantage in times of crises in supplementing some of the military requirements.

7.5.36 Home tracts of the breeds, viz., *Manipur* for *Manipuri* and *Rajasthan* for *Marwari* and *Gujarat* for *Kathiawari* breed, would be the logical locations for horse breeding farms and for maintenance and development of breeds of riding horses. *Jammu & Kashmir* and *Himachal Pradesh* would be suitable for the development of the *Bhutia* breed. In consideration of the small number of 'good' specimens that are now left in different breeds, it would be preferable to concentrate on development work of each breed only at one centre, to begin with. There should not be any great difficulty for the State Governments to locate suitable sites and enough land for establishing horse breeding farms, but they would possibly require technical expertise and guidance from the Central Government, at least in the initial stages. Preservation and development of indigenous breeds of horses should be undertaken as Centrally sponsored programmes on the lines of establishment of Cattle Breeding or Sheep Breeding Farms.

7.5.37 In addition to horse breeding farms in the States, a National Equine Breeding Farm (NEBF) under direct control and management of the Central Government should be established with the objective of producing high class stallions and brood mares of different breeds as also donkey stallions, as are presently being done by the military estab-

blishments. Such an organisation will serve as a second line of defence for the military establishments to fallback upon in the event of an emergency. The NEBF should, in a small way, make a beginning in breeding race horses in the public sector, with a view to serving as an additional check on various alleged malpractices now being indulged in by private race horse breeders.

7.5.37 One of the prerequisites for breed development of livestock is to have clearly defined characteristics of a breed and a set of measurable standards for the assessment of the quality of animals. None of these essential prerequisites is available in respect of the indigenous breeds of horses. The ICAR should undertake the task of defining the Indian breeds of horses and specify the measurable standards for judging the quality of the animals.

7.5.38 For maintenance of records, State Departments should open Stud Registers. In addition to the animals in a farm that would find a place in the Stud Register, selected mares in neighbouring villages may also be registered. These selected mares should be included in the breeding programme so as to function almost as a part of the farm herd. The National Stud Register should be opened by the Union Ministry of Agriculture and Irrigation. All the imported stock of equines must be compulsorily registered and their particulars recorded in the Register. The progeny of these animals should also be registered.

7.5.39 Some immediate action is necessary to arrange for the breeding of the local female equine stock with some superior type stallions. Some of the States like Gujarat, Haryana and Punjab were stationing horse or jack stallions in veterinary hospitals or other locations for horse, donkey and mule breeding. Many of such stud centres have since been closed down mainly because of insufficient use of the stud animals. In the interest of equine breeding, a reappraisal of the situation should be made and steps should be taken by the State Governments, where equines are important, for reopening the centres and increasing the number of horse and jack stallion studs. Maintenance of proper records of matings, foals born, survival rate of the young and preferably its performance and disposal are essential for all stud centres. This was sadly neglected in the past in most of the stud centres.

Camel

7.5.40 In the livestock census, besides enumeration of population, no other information on camel is available. The Committee for advising the Government on the characteristics of different livestock on which information should be collected during livestock censuses referred to earlier should also consider the essential information on

camels that should be collected for effective planning for development.

7.5.41 There is a distinct shift noticeable in the utilisation of camels for meeting changing human requirements. In the past, camels were prized most for their speed of travel and capacity to traverse long distance at a stretch in the desert. With the development of desert regions, construction of roads and with introduction of mechanised transportation, the importance of the camel as a means of transport in the desert is decreasing, but its importance is increasing for agricultural operations. This brings in its wake newly developing situations in management of camels concerning both breeding and feeding.

7.5.42 So far, management of camels for breeding and feeding could be best accomplished by keeping the animals under ranching conditions, where they could obtain good grazing and browsing over-extensive land areas. Such management conditions enabled camel breeders to maintain large breeding herds economically to make camel breeding profitable. Large herds also provided scope for greater intensity of selection for producing superior quality animals.

7.5.43 The situation has greatly changed for camel breeding even in Rajasthan where the camel is one of the most important livestock. Continuous diminution in the areas available for camel grazing due to increased cultivation, legislation on preservation of forest and closing the areas altogether to camel grazing and reclamation of large tracts previously used for camel grazing for the canal projects have perforce led to camel breeding activities getting limited to restricted localities. One of the consequences resulting from the squeezing of the breeding activities is that the distinct types of camels that existed in the past in Rajasthan are getting mixed together, and they may lose their separate identities. Except in Rajasthan, where the camel breeders were keen in retaining and improving the breed types, breeding of camels in other parts of the country was practised in a haphazard manner without any consideration of a particular type. The result was the production of crossbred or *dogla* camels which can be found throughout the country. Research studies on camels should be undertaken at the agricultural universities regarding the types of camels that would be most suitable for different agricultural operations to which they are being put to in increasing numbers.

7.5.44 Keeping the camels under stall feeding is expensive as the cost of maintenance of the animals would be prohibitive. However there is some scope left for camel breeding in Rajasthan and Kutch by maintaining the animals on grazing under ranch conditions. Desert areas in Bikaner and Jodhpur, the hilly areas of Udaipur and Kota and extensive areas in Kutch provide facilities for grazing. As a grazing ground, Kutch may be even superior to Rajasthan. For mass scale pro-

agation of breeding stock and production of superior quality stud animals, camel breeding activity should be kept concentrated mainly in these two areas. Organisation of efficient cooperative societies of camel breeders would be of help in procuring good quality stud camels, obtaining better grazing facilities for the animals, securing institutional credit facilities and in obtaining profitable marketing channels for the animals they produce. The Animal Husbandry Departments of Rajasthan and Gujarat should take the initiative in organising the camel breeders into cooperative societies. Financial assistance and technical guidance necessary for this purpose should be provided by the concerned State Government.

7.5.45 Keeping in view the fact that only a few good quality stud camels are now available, serious consideration should be given to the use of AI in camels. It is reported that AI has been used with good success in the USSR. This system of breeding does not appear to have been attempted so far in India and the technique of AI in camels is also not known in the country. The possibilites of training one or two young well qualified and competent persons in the Department of Animal Husbandry, Rajasthan in AI of the camel in the USSR for a period of six months or so may be explored.

7.5.46 For hand mating of camels in Rajasthan, Haryana and Gujarat, stationing of stud camels in suitably located centres and the operation of the centres broadly on the pattern of Key Village Scheme for cattle development have been recommended in the Interim Report on Desert Development. Such facility should be developed also in Punjab.

7.5.47 Very little scientific studies have so far been done on camel nutrition and on formulation of least cost balanced ration from locally available ingredients for the camels engaged in different kinds of work. These studies should, therefore, be undertaken without any delay.

7.5.48 The available information shows that surrah (trypanosomiasis) is the most serious disease of camels in India. Several proprietary drugs like 'naganol', 'antrypol' and 'antrycide' are highly specific for the treatment of surrah, but all of these are in very short supply as these have to be imported. Arrangements for their manufacture in the country should be made at an early date. However, till these drugs become available indigenously, the Union Ministry of Agriculture and Irrigation should ascertain the countrywide requirements of these drugs for the treatment of camels and equines from the State Directors of Veterinary Services and arrange for their import. Scientific knowledge on the physiology, nutrition, husbandry, disease incidence, parasitism etc. of the camel is, however, still very meagre. The ICAR should initiate research studies on these aspects of the camel, in which know-

ledge is inadequate, in the agricultural universities in Rajasthan, Gujarat, Punjab and Haryana, where the camel is an important livestock.

7.5.49 As recommended in the Interim Report on Desert Development, expansion of the Camel Farm at Bikaner is necessary for the research studies that should be undertaken by the College of Veterinary Science and Animal Husbandry of the Agricultural University of Rajasthan; and for other proposed camel development work. The linking of the expanded camel farm with a number of camel development blocks in different districts on the pattern of the Key Village Scheme has been recommended in the Interim Report. It was also recommended that the outlay for the expansion of the farm and its activities could be shared jointly by the ICAR, Government of India and the Government of Rajasthan as the camel breeding farm at Bikaner will help in the improvement of the stock in the neighbouring States as well. Camel development work requires several years to yield results. Therefore, action should be taken soon to implement the recommendations.

Yak

7.5.50 Yak will continue to be valuable in inhospitable, underdeveloped and difficult regions with poor transport facilities since these animals are able to thrive and provide useful products for the inhabitants in those areas under conditions which other livestock, particularly the more productive ones, are unable to withstand. If and when these areas are developed, it would prove more profitable to maintain other more productive livestock. Even if the area is not developed but good communication roads are constructed, it would possibly be more economical to transport the livestock commodities from the areas where those could be produced at much lesser cost rather than attempting to produce the livestock products locally at considerably higher cost.

7.5.51 A great handicap in the planning for development of the yak is the lack of knowledge about the animal. This is one of the least studied domestic animals. Published literature on yaks is extremely scanty and no research investigation to study the physiology, disease incidence or husbandry of these animals appears to have been made so far. Most of the information collected in the ICAR survey on Yak is based on oral enquiry without any direct observations. The authenticity of the information obtained by oral enquiry is questionable. As such, it would not be advisable to plan for yak development on background information of questionable value. In Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh some schemes were initiated for yak

development in the sixties without any proper planning. The schemes for improvement of the species were limited to purchase of 'selected' healthy yak males from the villages, and stationing these animals at chosen locations for production of better quality yaks and yak crosses. The selection of the male breeding yaks was based entirely on phenotypic body characteristics of the animals. There was no proper record keeping to assess the results of operation of the schemes. It is not surprising that no tangible results have come out from such attempts at improvement of yaks.

7.5.52 The Himachal Pradesh Government has established a yak breeding farm near Chitkool in Sangla valley which has recently been handed over to the Agricultural University, Himachal Pradesh for research and development. This is a move in the right direction since it is essential to gather a great deal more knowledge about the yak by systematic research studies to make effective planning for yak development. But research investigations on yaks relating to physiology of nutrition, reproduction and production, disease incidence and pathology of the common and more serious diseases and husbandry should be carried out by really capable and highly qualified persons, as practically nothing is known about the animal on these important aspects. Beside this, because of the limitation of the size of the yak herd at Chitkool, it is essential that field studies on the yaks at selected locations should be undertaken. Along with research studies to learn more about the animal, socioeconomic studies should also be undertaken to ascertain the economics of utilisation of yaks for different purposes and the social implications of yak rearing. With such combined studies, it should be possible to formulate effective plans for yak development in future and relating these to the economic betterment of the yak owners. The ICAR should initiate a coordinated research programme for yak development in Jammu & Kashmir and Himachal Pradesh.

6 MIXED FARMING

7.6.1 The average size of holding in India is very small, being only 2.3 hectares. Subsidiary occupations like raising of livestock in combination with different crops, therefore, become a necessity for the farmers to make the maximum use of their limited resources and labour capacity in order to supplement their present income.

7.6.2 The information contained in the farm management studies does not help in making even a rough estimate as to the contribution livestock rearing makes to the farmer's economy. Information on the productivity of livestock and the feeding and management practices fol-

lowed in the different regions is also not available. In view of the increasing demand for livestock products such as milk, meat, egg and wool, and the importance now being given to livestock production, it is necessary that collection of data on livestock rearing practices must be given more attention in farm management studies.

7.6.3 Even though Indian farmers generally practise mixed farming in one form or the other, yet it has not been adopted in full by the Indian peasantry as it should have been. This is mainly due to absence of superior livestock with genetic potentials for high productivity, shortage of feed and fodder, lack of knowledge of proper land use and crop rotations among small farmers, difficulties in obtaining easy and timely credit, lack of marketing facilities etc. Thus, mixed farming practices never became a remunerative system of farming, particularly for the small farmers. To improve the lot of this section of the farming community, the essential inputs of mixed farming in a package, as mentioned above, will have to be ensured. The combination of all these factors will give the maximum return from a unit. It is also necessary to carry out investigations in detail on the possible contribution the rearing of dairy animals, sheep, goats, pigs and poultry can make to the economics of farming under Indian conditions. Potentialities of sericulture and apiculture should also be studied in this context. In most of the studies/investigations carried out in the past, results have not been entirely free from bias and ambiguity, and as such, it is necessary that detailed studies should be taken up in various agroclimatic regions of the country for determining (a) the minimum economic unit and type of the livestock for each unit of holding for a specific regional situation; (b) the increase in income in a mixed farm that is attributable to livestock and other component; and (c) the extent of utilisation of potential farm family labour and farm livestock. Care has to be taken that all the aspects and combinations of agricultural practices such as growing of grain, cash and vegetable crops, growing of fruit trees or orchards, tea and coffee plantations, rearing of cattle for milk and draught, sheep for mutton and wool, goat for milk and meat, pigs for pork and poultry for eggs and meat, rearing of silkworms for silk, beekeeping for honey and wax production and fish for food, are covered for the benefit of the farmers in different regions. When satisfactory data are obtained and definite conclusions arrived at on the most suitable combinations for different situations, the ICAR should organise a large number of demonstrations on mixed farming on the lines of other National Demonstration Projects in crop production.

7.6.4 There are certain areas in the country where crop raising alone cannot provide sufficient income for the economic well being of

the farmers due to frequent natural calamities like drought, floods etc. These areas offer opportunities, for raising livestock and, therefore, livestock rearing should invariably be encouraged. Such situations exist in the arid zones, drought prone areas and in the hills, particularly at high ranges. In these areas, as irrigation facilities are highly inadequate, cultivation is restricted to periods of rainfall and, thus, livestock raising gives opportunities for off season utilisation of family labour. As already recommended in the Interim Report on Desert Development, in the areas commanded by the Rajasthan Canal and the proposed additional lift canals, cattle breeding for milk production should be encouraged and that a mixed farming pattern of agriculture should be popularised. In that Report the scope for taking up improved sheep rearing along with crop production through some of the farmers in the eastern districts of Rajasthan such as Churu, Nagore etc. has also been pointed out. Farmers should be encouraged to earmark some area as pasture for sheep, and they should be provided financial assistance for undertaking land development, use of fertilisers and reseeding their grasslands.

7.6.5 In the high ranges of Kerala State, the experience from the working of the Indo-Swiss Project has shown that improvement of cattle, mostly owned by small farmers, through crossbreeding for higher milk production could go a long way in augmenting the income of the farmers in these areas. Efforts are also being made for improvement of grasslands in this region for ensuring better forage for cattle. Similar experience has also been gained in the areas covered by the Indo-German Project in Mandi (Himachal Pradesh) and in Almora District (Uttar Pradesh). In the high altitude areas of the western Himalayan region encouragement should be given for rearing small stationary sheep flocks in the apple orchards in Himachal Pradesh and Jammu & Kashmir. The Jammu & Kashmir Government has already taken up a programme for sheep rearing as a supplementary occupation by farmers having small orchards. Pork consumption is quite popular in the tribal areas and in the eastern Himalayan region. In the latter, improvement in the quality of pigs has already been made to some extent. The role of piggery development in improving the economy of the small and marginal farmers and agricultural labourers has been emphasised and a programme of piggery development suggested in the Interim Report referred to earlier. The programme should be implemented on a priority basis to integrate pig rearing as a mixed farming practice by a large number of farmers in these districts. So far as poultry raising is concerned, this could be introduced in all the areas of the country. In all areas having good scope for marketing eggs and poultry, the keeping of birds on backyard farming basis and in smaller

units and in deep litter system should be popularised as a mixed farming venture.

7.6.6 In order to make a dent into the rural poverty and to extend the benefit of planned development to the small cultivator and underprivileged section of the rural population, special programme (SFDA and MFAL), particularly suited to these classes of people have recently been launched by the Government of India. Under these projects, crop production no doubt will receive major emphasis. The possibilities of supplementing small farmers' income and utilisation of farm family labour more profitably, which otherwise might have remained partially or wholly idle through subsidiary occupations like the rearing of cattle, sheep, pigs and the raising of poultry should receive special attention. Therefore, the livestock production enhancement programmes in the country should be concentrated on encouraging a mixed farming system which would *inter alia*, help in the improvement of the economic lot of the small farmers.

7.6.7 The livestock maintained by farmers practising mixed farming should be efficient converters of fodders and feed to milk, mutton, wool, eggs, etc., and utilise them better for body growth. Otherwise, the raising of fodders in place of other crops would prove uneconomical. Keeping this aspect in view the farmers should be helped to produce good quality livestock on their own, or supplied with high yielding livestock. Further, a suitable marketing channel between the village marketing cooperatives or the agricultural marketing societies and the farmers should be organised for promoting mixed farming.

7 LIVESTOCK FEEDING

7.7.1 Quantitative and qualitative insufficiency of feeds and fodder in the country is one of the main impediments in the way of improvement of livestock production. The reasons for the shortage of feeds and fodder are many. Area under fodder is very small due to greater need and profitability of land used for cereals, fibre and cash crops. The fodder production per unit area of land for a large part of the year, and in certain years, is very low due to adverse climatic conditions. Besides, the low industrial base reduces the availability of by-product feeds. Considerable loss occurs in monsoon grasses because they are not harvested when they have the optimum nutritive value. This may be for want of time, equipment or even manpower. Delayed maturity and poor rate of reproduction of livestock further force the stock owners to increase the number of unproductive follower stock, thereby making the problem of feed shortage more acute. With the availability of better animals, a much smaller number of livestock will

be able to produce as much, if not more, food, fibre or work for human use. In certain areas especially of high rainfall, soils are leached out of essential nutrients leading to their deficiency in feeds and fodders. In some areas toxic elements like fluoride, selenium, molybdenum etc. may cause health hazard to the animals. Identification of such regions and rectification of deficiency or toxicity in feeds and fodders may open up newer areas where livestock can be gainfully raised.

7.7.2 Studies should be carried out to determine the optimum nutrient requirements and feeding level under different physiological conditions for production of work, meat, milk, eggs and wool. These studies should be updated every five years, compiled and published as a guide for scientific and economic feeding of livestock. Studies should also be undertaken to develop standard methods of estimation to evaluate total feed availability and requirements of feeds.

7.7.3 According to the Committee on Livestock Feeds and Fodder (1974) of the Ministry of Agriculture and Irrigation the availability of concentrates, dry fodder and green fodder in 1973 was only 11.05, 309.00 and 214.5 million tonnes as against the requirements of 19.56, 347.41 and 343.57 million tonnes respectively. The estimated requirements of livestock feeds in 2000 AD are 82.8 million tonnes of concentrates of plant origin, 373.0 million tonnes of dry fodder and 594.8 million tonnes of green fodder, while the availability is expected to be only 77.05, 356.8 and 575.0 million tonnes of concentrates, dry fodder and green fodder respectively. It is, therefore, essential to find ways and means to bridge the widening gap between requirement and availability of feeding stuffs.

7.7.4 Efforts should be made to decrease livestock number by using available stock more efficiently and feed utilisation should be increased by improvement in feed handling and feeding practices, particularly by feeding balanced rations. Available feeds should be used for feeding of productive animals and their followers, and the unproductive animals should be progressively eliminated. Restrictions on grazing and/or levying of progressively heavier charges on 'free' grazing should be introduced as a means for the elimination of uneconomic cattle and other livestock and for improvement of pasture yields through systematic grazing and scientific management of grazing lands.

7.7.5 Livestock in India obtain a considerable amount of their nutritional requirement by grazing. Particular attention should, therefore, be given to improve pastures and grazing areas, owned by individuals or jointly by the community, through controlled grazing and introduction of nutritious grasses and legumes and application of fertilisers. In areas where intensive livestock production programmes are taken up, a study should be made of the cycle of growth, produce-

tivity and nutrient yield of the locally available natural grasses. The potential for improvement should be evaluated and action programme drawn up by teams including experts in grassland management, livestock development and agricultural economics. Efforts should also be made to rejuvenate and maintain productivity of overgrazed pastures and to increase utilisation of presently underutilised pastures and grazing areas due to inaccessibility. There should be coordinating bodies in the State headquarters consisting of heads of Departments of Forest, Sheep Developmnt, Animal Husbandry, Dairy Development and Agriculture for planning conservation and utilisation of grasslands and hay. Similar committees will also be necessary at the district level. Cutting of grasses from inaccessible areas (as opposed to grazing by animals), and its storage in fodder banks, should be encouraged. Concessions should be given for the transport of baled hay from railheads to rural areas of intensive livestock production. These concessions should not be available for urban areas.

7.7.6 Research for evolving high yielding varieties of fodder grasses and legumes and for development of cultivation practices should be intensified so that higher economic returns can be obtained for land, capital and labour used for fodder in comparison with other uses of land. In areas where intensive livestock production is taken up, cultivation of fodder should be encouraged by educative propaganda, advice, supply of seed materials and fertilisers. Silage making from seasonal surplus of fodders grasses and other plant material may be adopted by large cooperatives of milk producers or producers of other livestock products on a cooperative basis. In hilly areas, where surplus grass is available and conditions for hay and silage making are not favourable, artificial drying of forages may be practised. Feasibility studies regarding the economics of such enterprises may be conducted by the IGFRI and agricultural universities. In each intensive livestock production project, a survey of feeding practices should be conducted to minimise waste and to utilise nutritive fodders more efficiently. An Animal Nutrition Officer should be employed for each major intensive livestock project. While selecting varieties of foodgrains for extensive cultivation, special varieties with high yield of total nutrients for livestock feeding should be given due importance. Research and extension on high yielding coarse foodgrains should be intensified. Improved milling of rice should be popularised to make rice bran of suitable quality available for feeding animals. As solvent extracted rice polishings have better keeping quality, and can be used for livestock feeding, the extraction of rice polishings for recovery of oil should be encouraged.

7.7.7 Proper processing of byproducts for feeds should be made

a condition for licensing of food industries so that suitable by products in larger quantities are made available for feeding of livestock. Feasibility studies should be carried out to determine the economics of taking over the raw byproduct by the compounded feed industry for further processing and use. Feeding of cotton seed should be discouraged through educative propaganda. It should be replaced with cotton seed cakes and other cheaper substitutes for saving oils for other use. The substitutes, or compounded feeds, should be provided to the users at reasonable costs and in adequate quantities.

7.7.8 Research should be initiated to identify the harmful substances in nonedible oilcakes and other byproducts and to devise commercially feasible methods for making these cakes suitable for livestock feeding. Solvent extraction of oil cakes should be encouraged to increase availability of oils and decrease cost of cakes as livestock feeds. Vigilance should however, be directed to enforce that solvents carrying harmful residue's in cakes are not used for extraction. Soya-bean cake is of high value for livestock feeding. As such soyabean production should be expanded.

7.7.9 Improved methods of processing inedible fish and fish industry wastes into fish meal including the setting up of small sized rotary fish meal plants, developed by the Central Institute of Fish Technology, at fish landing centres and fish factories should be encouraged, preferably in the cooperative and small scale sectors. The State Animal Husbandry Departments should ascertain the availability of kitchen wastes from large hotels, messes, catering establishments set up by the tourist corporations, airlines, teaching institutions and private concerns. The economics of their use as livestock feed, with or without processing, should be studied.

7.7.10 Molasses should be allotted to the livestock industry in adequate quantities at reasonable rates for enriching feeds and fodders with urea and for pelleting feeds. The use of sugarcane tops as livestock feed should be encouraged. Research on processes like derinding of canes for use as feed should be undertaken.

7.7.11 Reasons for the inadequate availability of bone meal and other ingredients for mineral mixtures and additives for balanced livestock feeds should be studied. The livestock feed manufacturers in the public, private and cooperative sectors should develop resources of these scarce materials. The State Governments may utilise provisions in the existing laws for making scarce raw materials available to the compounded livestock feed industries at reasonable cost.

7.7.12 Import of lysine and methionine should be allowed so that these aminoacids can be added to poultry and pig rations. The pharmaceutical industry should be encouraged to manufacture these essen-

tial aminoacids within the country. Arrangements should be made for the manufacture of feed grade urea in India and popularising its correct use for feeds and fodders.

7.7.13 Unconventional byproducts from slaughter houses, fallen animals, distillary wastes, canning industry, starch industry, forest by-products, sea weeds, algae etc., which are not utilised or inadequately utilised, should be exploited for augmenting feed resources. Research on this aspect both in the laboratory and field and extension programme should be intensified on a continuing basis.

7.7.14 Studies should be undertaken to evolve more economical balanced feeds for livestock without any sacrifice of nutritive value for productive purposes, and to compare the economics of these rations with traditional methods of feeding livestock in different parts of the country. Sufficient incentives during the first few years should be provided to livestock owners so as to encourage them to change over to balanced compounded feeds particularly for improved animals and their growing youngstock. The State Animal Husbandry Departments should have laboratories where feed samples can be got analysed by the producer, seller or purchaser.

7.7.15 While substantial quantities of livestock feed ingredients are being exported every year, the country is importing milk products from abroad. If the cattle feed is used within the country, the internal production of dairy products will go up. As such, the livestock feeds required for internal consumption should not be exported. It should, however, be ensured that the livestock feed diverted from export is fed to high producing livestocks. For this purpose, an efficient organisation should be built up, for transfer of feed from places of production to areas of intensive livestock production.

7.7.16 The economics of export of livestock feed *vis-a-vis* export of livestock products should be studied so that loss of foreign exchange through diminished export of livestock feed ingredients may be made good to the country's advantage through the export of livestock products.

7.7.17 Legislation similar to that of Food Adulteration Act should be enacted and enforced to ensure that only feed materials and compounded feeds which conform to the quality standards, are sold.

7.7.18 Practically no work has so far been done to find out the biochemical pathways in which the feed nutrients are utilised for growth and production of milk, eggs, wool etc. Studies in this direction should be initiated so that the interaction of different metabolites on ultimate production levels could be understood, which in turn will help to determine the specific nutrients requirements of economic traits.

7.7.19 Every State Animal Husbandry Department should have an officer at a fairly high level to coordinate development and extension of livestock feed production, procurement compounding and distribution. In order to coordinate the work of the State Animal Husbandry Departments in the field of livestock feeding there should be a Specialist on Animal Nutrition in the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation. A post of Assistant Director General should be created at the headquarters of the ICAR for coordination of research activities in the field of animal nutrition at the various research institutes and veterinary and agricultural colleges.

7.7.20 Several recommendations made in this section would involve considerable intensification of research in the field of animal nutrition and allied subjects. As such, an Institute for Animal Nutrition Research should be established at an early date. This Institute should work in close cooperation and coordination with the existing centres of animal nutrition research at the ICAR/Institutes and in agricultural universities.

8 ANIMAL HEALTH

7.8.1 Without adequate health cover, all attempts to improve the production capacity of livestock are foredoomed to failure. This applies particularly to the programmes of improving the production of indigenous stock by crossbreeding with exotic animals, as exotic and crossbreed animals are more susceptible to the diseases and pests prevalent in India. Consequently, the necessity for an efficient and well-knit animal health organisation has become all the more imperative.

Clinical and Preventive Veterinary Medicine

7.8.2 The number of veterinarians for about 26,000 cattle units in the country is inadequate to ensure the health and production of livestock. There should be at least one veterinarian for every 20,000 cattle units by 1980, 10,000 cattle units by 1990 and 5,000 units by 2000 AD. In areas of intensive livestock production, it would be necessary to have one veterinarian for every 10,000 cattle units from the Fifth Plan period itself. Veterinary services in such areas may be provided through the cooperatives as has been done by the Kaira District Cooperative Milk Producers' Union in Gujarat State.

7.8.3 At present most of the veterinary hospitals are poorly equipped, do not have modern aids for arriving at prompt and correct diagnosis of diseases, and lack facilities for undertaking surgical operations, particularly in the field of obstetrics and gynaecology. Even

drugs for treatment of common ailments are in short supply. There is, thus, an urgent need to considerably improve the quality of veterinary service in the country. For achieving this, it will be necessary to supplement the funds of the Veterinary Departments, which should introduce immediately a phased programme of levying a charge for the treatment of livestock including prophylactic vaccinations. All veterinary hospitals/dispensaries should have sufficient stock of medicines as well as facilities for routine laboratory examinations and undertaking surgical operations. A mobile veterinary clinic should be provided at every veterinary hospital for taking veterinary aid to the door of the livestock owner. Polyclinics should be established at district and state level in order to introduce multidisciplinary approach in combating animal diseases, reproductive disorders and nutritional imbalances.

7.8.4 In some hospitals there is a great demand for the services of veterinarians to attend to cases at the premises of livestock. Such demands will increase in these as well as in other hospitals. Two veterinary doctors should be posted in such hospitals so that when one goes for outdoor duty, the other may be available for attending to the cases in the hospital. Fees should be charged from livestock owners for such visits. Half of the amount of the fee should go to the veterinarian as an incentive, and the remaining half to the Government revenue.

7.8.5 Prophylactic vaccinations should be charged on a no-profit and no-loss basis from the beginning of 1985. However, the services rendered and the biologicals used under the national programmes of disease control and eradication should continue to be free till the objectives of these programmes are achieved. In the event of natural calamities such as floods, drought, large scale outbreaks of infectious diseases, vaccination work to control epidemics should also be carried out free of charge by the States. With the gradual development of a flourishing animal industry, more and more veterinarians will go in for private practice. The Government should encourage this by providing suitable incentives.

7.8.6 Adequate support of well organised disease investigation units and diagnostic laboratories is a basic requirement for improving the clinical and preventive veterinary medical service. As it is the responsibility of the State disease investigation centres to arrive at quick diagnosis of diseases, they should have specialists in diseases of different species of animals as well as in different disciplines directly related to the field of animal diseases. The centres should be equipped with adequate mobile and stationary laboratory facilities. Since the disease investigation centres are primarily meant to advise and assist

field veterinarians in controlling animal diseases, these should be under the administrative control of the State Directors of Veterinary Services* and not of the agricultural universities as is the case in one State at present. These centres should however, actively collaborate and draw on the expert advice and laboratory facilities of the constituent veterinary colleges of the agricultural universities, for which it would be necessary to suitably strengthen the departments concerned with disease diagnosis and investigation work in the universities.

7.8.7 At the national level, the IVRI, as the central research institute of the country, provides the necessary assistance to the States for tackling disease problems, which cannot be investigated at the State level. This makes it more or less obligatory for the disease investigation unit at the IVRI to have experts of a very high calibre, capable of rendering specialised service in their respective fields.

7.8.8. With increase in the imports of livestock and livestock products the chances of introduction of exotic infections have increased considerably. It has become necessary to establish an organisation, consisting of veterinarians specialised in exotic diseases, which can be pressed into service as soon as an exotic disease is suspected to have gained entry into the country.

Registration of Veterinarians

7.8.9 An Indian Veterinary Council, on the lines of the Indian Medical Council and statutory councils in the States should be formed immediately. The States are unanimously in favour of this proposal, as without registration of the veterinarians with such a statutory body (a) the prescriptions given by them for potent and poisonous drugs may not be served by the chemists and druggists under the Drugs Control Act; (b) their certificates for the purpose of export of animals and animal products or for interstate movement of animals or for the purpose of livestock insurance will not be legally acceptable; and (c) they will not have the legal authority to give evidence as an expert under Section 45 of the Indian Evidence Act on any matter relating to veterinary science.

Veterinary Biological Products

7.8.10 At present, most of the State production centres prepare only a limited number of biologicals and the State Veterinary Depart-

* The functionaries are designated variously in the different States as Director of Veterinary Services, Director of Animal Husbandry, Director of Veterinary Services and Animal Husbandry.

ments depend on the IVRI for meeting their requirements of the others. This arrangement does not seem to be working satisfactorily. Several infectious diseases are endemic and widely prevalent and the demand for vaccines and other biological products is enormous and is expected to grow further which cannot be met by the IVRI. Thus, there are frequent breakdowns in the supplies to the States, thereby causing serious setback to animal health coverage programmes. The State production centres should, therefore, be suitably strengthened and expanded on a priority basis so that they may be in a position to meet the full requirements of their respective States, at least in respect of the simple types of biologicals. As regards the more sophisticated products, the State biological production centres which have fairly good laboratory facilities and equipment, should be encouraged to take up their production and meet the demands of the whole country in respect of these sophisticated biologicals till the remaining States are also able to start their manufacture. The IVRI may concentrate on the development of technical knowhow and methodology for the production of new and improved biologicals.

7.8.11 Some of the State biological production centres though established many years ago have not yet come up to the desired standards. For improving the efficiency of the production centres, these should be allowed to function with some freedom from the usual restrictions of Government rules and regulations and should be run on commercial lines. For achieving this objective the State biological production centres should be converted into State Biological Products Corporations, and the Division of Biological Products of the IVRI along with the Foot-and-Mouth Disease Vaccine Production Centre at Bangalore converted into National Biological Products Corporation.

7.8.12 There is no need to set up independent biological production centres in the smaller States/Union Territories of Manipur, Arunachal Pradesh, Tripura, Meghalaya, Nagaland and Mizoram. Their demand can be more economically met from a Regional Biological Products Station. The management of such a Station could be vested in a joint body consisting of representatives of all the State Departments of Veterinary Services in the area, who could lay down the policies and programmes to be implemented. The Biological Production Centre, Gauhati after suitable expansion can be developed into a Regional Biological Products Station.

7.8.13 In order to plan systematically the expansion of the production programmes proposed above, an Expert Committee on Biological Products may be constituted by the Government of India to assess the special requirements of the State biological production centres in respect of laboratories, equipment and training of personnel, imported ducks and wiped out several consignments of Khaki Camp-

both in India and abroad. Another Expert Committee on Standardisation of Biologicals should be constituted to revise schedule F1 to bring it upto date.

7.8.14 A post of Controller, Veterinary Biological Products and Drugs with supporting staff should be created in each State to enforce the provisions of the Drugs and Cosmetics Act in respect of veterinary biological products and veterinary drugs so as to have an effective check on their quality. At the Centre, a post of Chief Controller, Veterinary Biological Products and Drugs, with supporting staff, should be created in the Union Ministry of Agriculture and Irrigation, and a Veterinary Biological Products and Drugs Advisory Board set up to advise on all matters concerning the veterinary biological products and veterinary drugs.

7.8.15 The Division of Standardisation of Biological Products of the IVRI, the only recognised laboratory for testing samples of biologicals for their quality under the Drugs and Cosmetics Act, cannot cope with quality control work of this magnitude in view of its multifarious responsibilities. A National Veterinary Biological Products Quality Control Institute, under the administrative control of the Union Department of Agriculture should be set up near some airport.

Control of Animal Diseases

7.8.16 In spite of developing a large number of highly efficacious methods and biologicals for protecting livestocks against diseases, the occurrence of several diseases in epidemic form still hampers the sustained development of livestock production. Along with the increasing tempo of development of higher productivity of livestock, efforts on control and eradication of their diseases will have to be adequately strengthened and reinforced.

7.8.17 An organised national programme for mass vaccination of cattle and buffaloes against rinderpest with the ultimate objective of its eradication from the country was started on October 1, 1954. As a result of this large scale vaccination campaign, the incidence of the disease has got drastically reduced. In 1974, only 231 outbreaks, causing death of 1,559 animals, occurred as against an average of 8,000 annual outbreaks killing about 200 thousand animals before the launching of this programme.

7.8.18 A stage has now come when a final thrust should be made to wipe out the disease from the few areas in which it is still persisting. For achieving this objective, the following strategy is recommended :

- (i) Necessary material from each and every suspected out-

break of rinderpest should be expeditiously subjected to laboratory examination.

- (ii) The source of each and every outbreak should be scrupulously traced and definite remedial measures taken to ensure that the lapses responsible for the outbreak do not recur.
- (iii) The number of checkposts on common cattle routes at the international and interstate borders and the number of vigilance units should be increased.
- (iv) As wild animals may act as reservoirs or carriers of rinderpest virus, all cattle and buffaloes going into the forests for grazing should be vaccinated at the forest checkposts.
- (v) The Veterinary Departments should intensify the follow up vaccination programme.
- (vi) Stamping out policy, i.e., the destruction of affected animals on payment of compensation and ring vaccination with rinderpest tissue culture vaccine around scenes of outbreaks of the disease, should be gradually introduced.

7.8.19 In case of sheep and goats and also pigs a more practical approach would be to follow the stamping out policy as for cattle and buffaloes.

7.8.20 Systematic epidemiological studies with particular reference to the role of carriers or reservoirs in the dissemination of the disease should be undertaken. Further studies on rinderpest in sheep, goats and pigs should be intensified to determine the duration of immunity conferred by the rinderpest tissue culture vaccine in indigenous, crossbred and exotic cattle as well as in buffaloes, sheep, goats and pigs should be carried out.

7.8.21 Little success can be expected in the improvement of the livestock industry unless foot-and-mouth disease (FMD) is effectively brought under control. A national programme for its systematic control should, therefore, be taken up immediately, the approach being (a) to carry out scientifically planned prophylactic vaccination campaigns on an extensive scale and (b) to check the spread of infection by undertaking ring vaccination around the scenes of outbreaks and by enforcing strict hygienic measures. However, nonavailability of the FMD vaccine in sufficient quantities and its high cost are the main hurdles in the implementation of the vaccination programme. Production of the vaccine should, therefore, be stepped up immediately and efforts made to reduce its cost of production.

7.8.22 Out of the seven major immunological types of foot-and-mouth disease virus; only four, viz., O,A,C and Asia I, have so far

been recorded in India. It is, therefore, extremely important that quarantine measures are rigorously enforced to ensure that SAT I, SAT II and SAT III or any other new strain do not gain entry into the country. The virus typing service should be suitably strengthened so that the epidemiology of the disease under Indian conditions is better understood. This will help in selection of the most commonly occurring antigenic types for the manufacture of more efficacious vaccines against FMD.

7.8.23 With the launching of the piggery development programmes, the FMD in pigs has assumed great importance, but unfortunately, no effective vaccine against the disease in pigs is yet available. The IVRI should intensify research on FMD in pigs and take early steps for the production of an efficacious and inexpensive vaccine. Research work on this disease in sheep and goats, with particular reference to the study of its epidemiology, should also be intensified, as these species may be playing an important role in spreading the infection over wide areas. As FMD is a very serious disease, whose control is to be taken up on a national scale, it would be desirable to constitute a National Advisory Committee on Foot-and-Mouth Disease to supervise the control programme, and to offer expert technical guidance in its implementation.

7.8.24 As tuberculosis among animals has become a serious threat to the developing dairy industry, a systematic programme to control the disease among animals, with the ultimate objective of its eradication, should be immediately taken up at the national level. Also, considering that the Brucella infection is widespread in organised herds of cattle and buffaloes, and that some of these herds have as high as 20 to 30 percent positive reactors, brucellosis should be systematically controlled and eradicated on a priority basis in the interest of livestock industry and of public health.

7.8.25 For implementation of the eradication programme in respect of tuberculosis and brucellosis, an Eradication Officer assisted by a team of veterinarians for testing tuberculosis and brucellosis will have to be appointed for these two diseases in each State. It would also be necessary to appoint a Chief Tuberculosis and Brucellosis Eradication Officer at the Centre in order to coordinate and guide the programme on a countrywide basis. A National Tuberculosis and Brucellosis Eradication Committee should be set up to chalk out a detailed technical programme, to lay down important guidelines for its implementation and to exercise supervision over the progress of the Tuberculosis and Brucellosis Eradication Campaign.

7.8.26 The incidence of mastitis has already become a serious problem for the dairy industry. Researches conducted under the

auspices of the ICAR have provided information on the different microorganisms responsible for mastitis in India. Important guidelines for treatment and control of the disease under local conditions have also been laid down. What is needed now is an effective organisation to implement the programme. A well equipped laboratory exclusively for mastitis work should be established in each State. For field work, examination of milk samples from suspected mastitis cases may be undertaken at the veterinary hospitals and the chain of diagnostic laboratories. It may, however, be necessary to establish some additional diagnostic laboratories in the intensive dairy development areas as the number of milk samples required to be examined in these regions will be large. For the insidious cases, which will form a far larger percentage of the affected animals than the clinical cases, implementation of control measures pose serious practical difficulties. To overcome this great impediment, a massive audiovisual programme should be launched to educate livestock owners regarding the economic gains that will accrue from the mastitis control campaign.

7.8.27 As it may not be economically feasible to set up a Government organisation for routine clinical examination of the large population of dairy animals for mastitis, direct involvement of livestock owners is necessary. With a little training they should be able to use the simple strip-cup test as a routine measure to detect cases of mastitis and report to the nearest veterinarian, who will then arrange for professional examination and treatment of the animals through mobile laboratories and clinics.

7.8.28 Epidemiological maps indicating the endemic areas of haemorrhagic septicaemia, anthrax and blackquarter should be prepared by the State Veterinary Departments and a more systematic vaccination programme should be taken up in the endemic areas.

7.8.29 The mortality from contagious bovine pluro-pneumonia (CBPP) came down to about 27 deaths in 1961-62 as compared to 1,036 in 1956-57. There has been a definite setback to the control programme between 1970 and 1975. A Committee of Animal Disease Specialists should be constituted immediately to carry out a thorough on-the-spot study of the factors responsible for the increase in mortality due to CBPP and lay down a systematic policy for its eradication within the shortest period. CBPP, now confined to a few districts in Assam, should be eradicated as quickly as possible by stamping out policy.

7.8.30 Fascioliasis (liverfluke disease) is widely prevalent in India and is one of the major limiting factors in the improvement of cattle in marshy and waterlogged areas, both in the plains and the hilly regions. Livestock owners will have to be educated on this disease.

The control programme would involve large scale surveys to delimit the endemic areas in each State. In each of the States where fascioliasis is a serious problem, one Liver Fluke Control Officer should be appointed to get the survey and control work done through the network of the existing veterinary dispensaries and hospitals. With the available drugs and technical knowhow and with active participation of the livestock owners the disease can be successfully brought under control.

7.8.31 Research work on fascioliasis, particularly on ecological behaviour of the intermediate host and the effect of different molluscicides on the snails and the environment, should be intensified. Molluscicides, which are not affected by the organic matter of ponds and pastures should be tested under field conditions to find out the most suitable drugs for liver fluke control programme. Similarly, the various drugs that are being marketed for treating fascioliasis in domestic animals should be subjected to carefully controlled trials to pick up the most effective and safe drug for field application. The State Animal Husbandry Departments should give priority to duck-raising programmes in the fluke infested areas as a step towards the biological control of snails.

7.8.32 In view of the colossal loss suffered by the livestock industry due to warble fly infestation, a systematic programme for its control should be taken up at an early date.

7.8.33 Theileriosis has been the biggest problem with the exotic animals as no specific treatment for established clinical cases is available. Suitable prophylactic vaccine has also not yet been developed against the Theileria strains prevalent in India. Research should be intensified on this disease, with particular reference to the study of the antigenic make up of the local Theileria strains, and for development of an efficacious prophylactic vaccine. Research work should also be undertaken to develop simple serological tests which could easily be applied in the field for detection of early and latent cases.

7.8.34 Among the infectious diseases of sheep, sheep pox is the most serious in the country. Unfortunately, the live sheep pox virus vaccine, now being produced in the country, has not been very effective in protecting sheep against the disease. Recently, the IVRI has prepared some brews of an inactivated sheep pox virus vaccine according to the Russian method which is reported to have given good results under laboratory as well as field conditions. Its large scale production should be undertaken immediately at all the biological production centres and the vaccine should be used for prophylactic immunization of sheep till a better product becomes available. In the meantime, research work should be intensified at the IVRI and at other suitable centres for developing a more efficacious vaccine.

7.8.35 It has been estimated that annually, on an average, 15,000 human beings succumb to rabies disease and more than 3,00,000 persons have to undergo antirabic treatment accounting for an annual labour loss of 4.2 million mandays. Very little systematic work to control rabies in animals has so far been carried out in India. Even the accepted routine public health measures, viz., vaccination and licensing of pet dogs and destruction of stray dogs are being practised in a half-hearted manner. Effective measures for control of rabies should be immediately undertaken.

7.8.36 Swine fever was not recorded in India till 1960, but the disease got introduced in the country with pigs imported during 1961-62. As a result of large scale vaccination with crystal violet inactivated vaccine and lapinised virus vaccine, the disease has been brought under control and no outbreak of swine fever was reported during 1972 and 1973. In 1974 there have been some cases of swine fever in Nagaland and Meghalaya. Should an outbreak occur in future in any State other than Meghalaya and Nagaland, stamping-out policy be followed. In case of Meghalaya and Nagaland, if the disease still persists and if the foci of infection have spread, prophylactic mass vaccination programme should be undertaken without delay. Till the time Meghalaya and Nagaland are absolutely clean of swine fever infection, free movement of pigs from these States to other parts of the country should not be allowed.

7.8.37 In order to meet any future emergency it should be ensured that adequate quantities of lapinised swine fever vaccine are stored all the year round at Izatnagar, Hissar, Ranipet and Calcutta, where the vaccine is being manufactured at present. The Biological Products Station at Gauhati should undertake the production and storage of this vaccine since extensive pig development work has been taken up in the north eastern region of the country. As swine fever is almost wholly under control, quarantine regulations should be rigidly followed in the case of all pigs imported from abroad. It will also be worthwhile to investigate if wild pigs or some other nonswine reservoirs of this infection exist, so that appropriate action may be taken for the elimination of the swine fever virus and for checking its spread to domestic pigs.

7.8.38 A comparison of the number of annual outbreaks of RD with mortality amongst the infected birds during 1964-1968 and 1969-73 has shown that the number of annual outbreaks has remained more or less the same while the rate of mortality has gone down considerably. Sporadic outbreaks continue to occur throughout the year in various States. For bringing down RD infection to an insignificant level, it is necessary to raise the target of vaccination to cover at least 80 per cent

of the poultry population within a couple of years, and to maintain this level of vaccination target for a period of about 10 years. At that stage, it would be worthwhile to start a pilot project in some selected areas, where vaccination may be stopped and reliance placed on hygienic and sanitary measures for keeping the poultry farms free of the disease. Should an outbreak occur in such an area, stamping-out policy be followed. If this approach proves successful, the programme should be gradually extended to bring more and more poultry farms in contiguous areas under its orbit till the whole country is covered.

7.8.39 Marek's disease struck many organised poultry farms in an epidemic form in 1969. Since the disease is highly contagious and has already spread over wide area, isolated attempts to control the infection in the different regions of the country are not likely to succeed. A National Programme for its control with the ultimate objective of its eradication should be initiated immediately. Marek's disease vaccine should be imported from abroad till it can be manufactured indigenously. Only turkey harpers virus vaccine should be imported till a better vaccine is available. Complete records pertaining to mortality and productive performance of the vaccinated birds should be maintained at farms, where vaccination is resorted to. These data should be carefully analysed by a Committee of Experts for finding out the effectiveness of vaccination as a method for control of Marek's disease.

7.8.40 Although mortality among poultry from Chronic Respiratory Disease (CRD) is not high, the disease is causing substantial losses due to lowered production, poor hatchability, reduced feed conversion, and retarded growth rate. Systematic control of CRD with the ultimate objective of its eradication is, therefore, of great importance for the success of the poultry industry. Production of antigen for serological diagnosis of CRD should be taken up by some more biological production centres so that the antigen is available in adequate quantity for the national control programme.

7.8.41 Pullorum disease is presently confined to a few small pockets and most States are free from this infection. Now is, therefore, the most appropriate time to launch a National Pullorum Eradication Campaign to stamp out the disease, and to take strict regulatory steps to ensure that the disease does not spread from the existing foci or gain fresh entry from exotic sources. The eradication programme should be initiated during the Fifth Plan with an aim to complete the work before close of 1980.

7.8.42 Duck virus hepatitis (DVH) has been a major killer of

bell ducklings. At present, no biological, either for active or passive immunization of ducks, is produced in the country. A suitable vaccine strain should be imported from abroad and DVH vaccine should be produced in biological production centres. It may also be worthwhile to prepare hyperimmune serum for treatment of the affected ducks. Since experience in the manufacture of vaccines antiserum against DVH seems to be lacking in the country, it may be necessary to depute a few officers to the Duck Disease Laboratory at Eastport, Long Island, USA, or some other suitable institute to learn the technique of production of these biologicals.

7.8.43 Vast majority of animals in India manifest subclinical syndromes of deficiency diseases in a complex form resulting from an overall low intake of nutritional substances. Hence the main problem is to bridge the wide gap that exists between the availability of the feeds and fodders and the nutritional requirements of the livestock population of the country.

7.8.44 In addition to the disease control programmes discussed above, it is necessary to undertake systematic control of diseases like Johne's disease, enterotoxaemia, babesiosis, anaplasmosia, schistosomiasis, amphistomiasis, coccidiosis, lungworm infestation, contagious caprine pleuro-pneumonia, fowl pox, fowl spirochaetosis, fowl typhoid etc. The major responsibility for control of animal diseases lies with the State Governments. However, in case of certain diseases, which are of special importance for developing the livestock industry of the country, it would be necessary to undertake nationwide campaigns for their control on the lines of the Rinderpest Eradication Programme. National Programmes, financed wholly or partly by the Government of India, should be taken up immediately for the systematic control and eradication of (a) Foot-and-mouth disease; (b) Tuberculosis; (c) Baucellosis; (d) Contagious bovine pleuropneumonia; (e) Pullorum disease and (f) Marek's disease. The Joint Commissioner (Livestock Health) in the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation should analyse periodically the trends in the incidence of the diseases and the progress achieved in their control on a countrywide basis and keep the States informed.

Legislation for Control of Animal Diseases

7.8.45 In order to prevent ingress of exotic infections, and to ensure effective check against spread of the infectious diseases in the country, the Livestock Importation (Amendment) Act, 1953 needs to be modified so that the authority to implement this Act vests with the Government of India, and not with the State Governments. Regula-

tions should also be added to control import of cultures of micro-organisms, semen and veterinary biologicals and to enforce laboratory examination of imported livestock products like eggs, meat, cheese, butter etc. Further, animals to be imported for zoological gardens should be brought under the provisions of this Act. Suitable legislation should also be enacted on a priority basis to regulate the inter-state movement of livestock to prevent the spread of diseases from one State to another.

7.8.46 An efficient animal quarantine organisation is essential to safeguard the health of livestock against the exotic diseases. However, in India this very important requirement of animal health has not so far received due consideration, and an effective quarantine service is lacking. As a result, certain exotic diseases like African horsesickness, swine fever, Marek's disease entered the country in recent years and caused heavy mortality in livestock. An effective animal quarantine organisation should therefore, be built up immediately. Enforcement of the quarantine and certification regulations should be entrusted to the quarantine organisation in the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation, which should be suitably strengthened. At present, quarantine stations do not exist on borders with Bangladesh, Burma, Bhutan and Nepal. As trade in livestock and livestock products is bound to increase, quarantine stations on Indian borders adjoining these countries should be established. All the quarantine stations should have adequate facilities for keeping animals under quarantine, and for carrying out laboratory examinations. It will also be necessary to accord official recognition to some well equipped laboratories in India having specialised facilities for undertaking specific tests so that their reports may be legally acceptable.

7.8.47 A sizable world market for the cattle and buffaloes and various livestock products of the country can be built up provided it can be ensured that the animals meant for export, and the areas they come from, are free from contagious and infectious diseases, and that prior to export the animals were properly quarantined. This can only be achieved if some pre-export quarantine units are set up in well-isolated locations, such as on offshore islands. There are several such islands where excellent isolation facilities can be created. Two pre-export quarantine stations may be set up during the Fifth Plan, and should the livestock export demands justify, more such stations may be established subsequently.

7.8.48 There is need for a well organised Animal Disease Intelligence Service (ADIS) particularly in a country like India where devastating diseases like foot-and-mouth disease, rinderpest, haemorrhagic septicaemia, anthrax, blackquarter, sheep pox, are still widely pre-

valent. The ADIS would enable reliable assessment of the incidence and trends of these diseases and the progress made in their control and help in making epidemiological forecasts and in planning vaccination and programmes more rationally and economically. A Central Bureau of Animal Disease Surveillance and Intelligence should be set up on priority basis in the Union Ministry of Agriculture and Irrigation. Every State and Union Territory should establish under the Directorate of Veterinary Services an Epidemiological Cell.

Veterinary Public Health

7.8.49 There is a great urgency for setting up a Veterinary Public Health Service (VPHS) in the country. As no organisation worth the name exists at present at any level, a proper infrastructure should be developed right from the municipal level up to the national level.

7.8.50 As for trained veterinarians required for manning the supervisory positions in the VPHS, the training programme already started at the All India Institute of Public Health and Hygiene (AIID & PH) leading to the award of Master degree in VPH, will meet the needs of the country. Regarding the training of veterinarians required for the VPHS at the municipal and district level, a three months' special training programme for veterinarians in the field of VPH may be instituted, which may run for one month each at the IVRI, the National Institute of Communicable Diseases and the AIID&PM.

9 MEAT PRODUCTION AND ANIMAL BYPRODUCTS

Meat Production

7.9.1 At present about 720 thousand tonnes of meat are being produced annually in the country. Against this, the demand for meat is expected to increase rapidly in the years to come. As indicated in chapter 3 on Demand and Supply the aggregate consumer demand for meat will range between 1.1 and 1.4 million tonnes in 1985, and between 1.6 and 2.1 million tonnes in 2000 AD. The annual per capita consumption of meat is projected to increase from 1.25 kg in 1971 to between 1.45 and 1.93 kg in 1985, and between 1.68 and 2.26 in 2000 AD. Urgent steps have, therefore, to be taken to enhance considerably the production of wholesome meat for human consumption.

7.9.2 The demand for beef and buffalo meat for domestic consumption is not likely to rise to any great extent till 2000 AD. However, there is considerable scope for building up an export market for

buffalo meat, especially to the countries in the Middle East. At present, only 15-20 tonnes of buffalo meat are being exported per day. Urgent steps should be taken to improve meat characteristics of the buffalo. Further, unwanted male buffalo calves, which, at present, are allowed to die prematurely, should be fattened quickly by giving them cheap feeds with supplements of molasses and urea. Meat from such animals will find a good foreign market. Unproductive buffaloes, which are surplus, should also be slaughtered for exporting their meat. The poor condition of such animals will not hinder export as there is great demand for 'lean meat' for soup manufacture.

7.9.3 One of the major hurdles in the production of wholesome meat under hygienic conditions is the primitive condition of slaughter houses. There are nearly 2,800 slaughter houses in the country operating under the local bodies but, excepting a few, many of them lack even elementary facilities for hygienic production and handling of meat, and for collection and utilisation of animal byproducts.

7.9.4 Socioeconomic factors, unfounded fears regarding municipalisation of the trade, creating an undercurrent of resistance among the operators and the butchers, relatively small returns expected from slaughter houses in the first ten years due to high capital costs and preference given by the State Finance Departments to other industries with short term higher returns, are responsible for the slow progress in the modernisation of meat production. Because of the nonavailability of suitable stockyards and livestock markets in the vicinity of the slaughter houses, the primary producers of meat animals cannot bring their livestock through cooperative trade channels, nor can they sell them directly to the retail butchers. The business is a monopoly in the hands of a few rich butchers and middlemen, who take away the cream of the profit. The primary producers of meat animals get insufficient incentive. Under proper management, a modern slaughter house can help break this vicious circle and ensure increasing supplies of quality meat. Modernisation of slaughter houses should therefore be taken up immediately.

3.9.5 The marketing of meat involves several agencies, intermediate operators or groups of them, and it is difficult to assess how many hands it has to change before it reaches the table. Various functions such as assembly of animals, slaughter, processing, storage, transportation and merchandising are performed by groups of individuals, each taking a very high margin of profit for services rendered. It is imperative to establish an organised marketing service for meat animals in the cooperative sector at least in cities and big towns. The livestock markets should be operated as terminal markets owned by the State Governments or cooperatives, and should provide facilities for yard-

ing, feeding and watering of meat animals. Veterinary services and banking facilities should be provided at these markets.

7.9.6 A study of the meat marketing system in the country has revealed that although the retail prices of meat have gone up considerably, proportionate benefit has not reached the primary producers so as to encourage more meat production. Economic pressures, and lack of information about the prices realised by the middlemen and the intermediate operators, force the producers to sell the animals at a relatively cheaper rate. A positive price policy should be evolved which ensures a fair price to the primary producers, and under which the consumers get good quality meat and meat products at a reasonable price. Since the problem of marketing of meat is a complex one, studies should be undertaken immediately by the Directorate of Marketing and Inspection, Government of India and State marketing organisations to work out how best this can be achieved.

7.9.7 The value of the exported meat and meat products which was only about Rs 144 lakhs in 1969-70 rose to Rs 684 lakhs in 1973-74. There is great scope for further rapid expansion. The increase in the export of meat has been mainly due to the functioning of the modern abattoir complex in Deonar, and high price of meat in the international market.

7.9.8 The export of chilled or frozen mutton has resulted in further shortage of meat for domestic consumption. As such, a tendency is developing amongst the butchers to slaughter immature sheep and goats to cater to the local demand. This is bound to further aggravate the present shortage. The export of meat and meat products should be brought under the control of some organised agency like the STC, and the quality control should be entrusted to the Directorate of Marketing and Inspection.

7.9.9 One of the basic reasons for the poor performance of meat industry is that the yield from the indigenous meat animals is very low. Exotic inheritance for improving the mutton and pork qualities of the Indian breeds of sheep and pig has, therefore, been introduced recently. This programme should be intensified. Further with a view to formulating a national policy for expansion and modernisation of the meat industry, and to advise the Government on connected problems, a Slaughter House Advisory Committee should be constituted under the Union Ministry of Agriculture and Irrigation. There is also an urgent need to strengthen the existing Slaughter House Unit in the Animal Husbandry Division of the Union Ministry of Agriculture and Irrigation so that it could provide necessary leadership and technical knowhow for setting up modern slaughter houses.

7.9.10 Modernisation of slaughter houses is essentially required

for production of wholesome meat under hygienic conditions and to salvage animal byproducts. In the initial stages setting up a modern slaughter house should be regarded as a development activity and not as a commercial venture. In order to provide incentive to the State Governments, the Central Government may give about 50 per cent assistance as direct grant for establishing one modern slaughter house complex in each State during the Fifth Plan. It is equally important to provide essential amenities and improve the hygienic conditions in the existing slaughter houses. The State Governments should provide sufficient funds for this purpose on a priority basis.

3.9.11 The scope of the Meat Food Products Order promulgated in 1973, which covers only processed meat at present should be enlarged to cover unprocessed meat as well. Further, the specifications laid down by the Indian Standards Institution for different types of meat and meat products should be rigidly followed so that the consumers are assured of the quality. A proper technical infrastructure should be built up immediately for enforcing the provisions of the Order.

7.9.12 There is an imperative need to impart implant training to technicians required to work in the modern slaughter houses. Such training courses should be arranged periodically by the Division of Animal Husbandry of the Union Ministry of Agriculture and Irrigation at the Deonar Abattoir, the CFTRI and the IVRI. Research work on problems connected with production, processing and storage of meat and meat products should be intensified at the CFTRI, IVRI and at some of the agricultural universities having facilities for this type of study.

Animal Byproducts and Animal Wastes

7.9.13 Utilisation of animal byproducts and animal wastes has not yet received due attention in India. There is thus a colossal loss on this score. With the development of transport facilities, gradual disappearance of sentiments against handling of carcasses of cattle and better organisation of collection agencies, the utilisation of animal byproducts and wastes will certainly improve. The rise in the economic return of animal byproducts will further strengthen this programme.

7.9.14 The estimated annual production of hides in the world is of the order of 6 million tonnes, out of which the share of India is 12 per cent. In view of the large bovine population, there is considerable scope for increasing export of hides through timely collection and improvement of their quality. In a highly competitive and quality

conscious world market, mere number may not be of much avail. Though India stands second in the world in the production of hides, and fifth in the matter of production of skins, it cannot forge ahead in capitalising on its large production unless stress is laid on quality right from the initial stages of production. As such, improved methods of flaying should be introduced in the slaughter houses and better flaying should be encouraged by payment of premia to good flayers. The All India Khadi and Village Industries Commission has set up a number of flaying centres in rural areas through the State Khadi and Village Industries Boards. For skilled flaying of larger number of fallen animals there is an urgent need for increasing the number of centres. Demonstration-cum-training centres should be established in important places for imparting training in curing, tanning and rational utilisation of hides. The Directorate of Marketing and Inspection should be suitably strengthened to carry out grading of hides and skins according to Agmark standards. Cold storage facilities for preserving raw hides and skins may also be provided, wherever possible. Before export, a system of compulsory preshipment inspection should be introduced, for ensuring quality.

7.9.15 There is a great demand in foreign countries for the casings produced in India. During 1969-70, casings worth Rs 231 lakhs were exported. Since then, export declined sharply. For effecting an improvement in quality and to increase the quantity of casings collected for processing, the first essential step is improvement in the conditions prevailing in the slaughter houses. Modernisation of slaughter houses, and provision of a byproduct wing in them, are absolutely essential. However, pending modernisation, an interim measure to improve the quality of the casings immediately would be to make provisions for adequate water supply in the existing slaughter houses so that the guts are cleaned properly within the precincts, and with the least possible delay. As guts are not removed in many slaughter houses soon after the slaughter of animals, and thereby deteriorate, it should be made obligatory on butchers to remove them within prescribed hours. The byproducts wing of each slaughter house should have a processing unit for guts under hygienic conditions. Guts may then be sorted out according to calibre, grade etc., thus making it easy for the exporter as well as the processor to do only the final grading. This would fetch a better price for the graded product.

7.9.16 According to an estimate made by the Directorate of Marketing and Inspection, annual production of bones in India in 1967-68 was of the order of 426,000 tonnes, and the collection is only about 40 per cent of the estimated availability. For increasing collection of raw bones, the formation of cooperatives of bone collectors

should be encouraged, and bone purchasing depots should be established in blocks. Further, flaying of carcasses should be allowed only at the flaying centres.

7.9.17 There were 100 bone crushing mills and about 360 bone digestors in the country at the end of the Fourth Plan. Most of the mills crush bones primarily with the object of exporting crushed bones and bone grists. The bone digestors are working on a cottage industry basis set up in various States for converting locally available raw bones into bonemeal for utilisation as fertilisers. New bone digestors will have optimum use if set up only in areas capable of utilising the bonemeal, preferably in remote places unconnected by rail or road. Cooperatives of bone collectors should be provided with bone digestors on rent. Encouragement should be given by the State Governments for setting up factories for the manufacture of gelatine, glue and Neat's foot oil.

7.9.18 There is considerable wastage of animal fats in India due to noncollection or delayed collection. Full and rational utilisation of animal fats, which are available in large quantities from fallen and slaughtered animals, is highly important. This would not only benefit the livestock producers but would also help in saving foreign exchange worth crores of rupees, which are being spent at present on the import of animal fats. All big slaughter houses, which are being modernised, should have a byproduct plant within their precincts or in close proximity so that all available fats from slaughtered stock could be processed. Efforts should also be made for efficient and quick recovery of fats from the dead animals.

7.9.19 India is one of the few countries which produce bristles of very high quality. There is need to educate the pig rearers and the bristles merchants regarding the economic importance of bristles, particularly as an earner of foreign exchange, so that more bristles are collected and dressed for export. The Indian brush industry deserves encouragement to utilise bristles of higher lengths, and also to make brushes of the standard and finish required by the affluent countries.

7.9.20 At present, blood is being collected only in a few slaughter houses of the country. According to the Directorate of Marketing and Inspection, the wastage of blood works out to nearly 64 per cent valued at Rs 78,60,000. Uncollected blood in a slaughter house becomes a serious sanitary problem. It quickly clots, chocking drains, septic tanks etc., and rapidly decomposes serving as an ideal medium for bacterial growth. Blood from all the slaughtered animals should be suitably collected and incorporated in the livestock feeds, or used as fertiliser.

7.9.21 Annual production of goat hair in India was estimated by

the Directorate of Marketing and Inspection at about 8,200 tonnes. There is a great demand for goat hair in foreign countries. Vigorous propaganda is, therefore, necessary to bring home to the goat rearers, merchants and others regarding the economic importance of goat hair and its proper processing for export.

7.9.22 The wastage in collection in the case of horns has been estimated at about 60 per cent, and in the case of hoofs at about 66 per cent. It is desirable that the wastage is reduced as much as possible and export trade in these items is increased. Further, horns and hoofs left in the country should be processed for the manufacture of gelatine, and the unutilised portion converted into meal for use as fertilisers.

7.9.23 The annual production of useless meat, i.e. meat condemned for human consumption and meat which remains adhered to the bones and other tissues, is estimated around 23,000 tonnes. Since useless meat is an excellent source of nitrogen in poultry feed and fertiliser for tea and coffee plantations, such meat should be converted into meat meal, and should not be wasted as is being done at present

Utilisation of Fallen Animals

7.9.24 It has been estimated that about 22.8 million carcasses of fallen animals are available annually. Out of these, hardly 53 per cent are being partly utilised and the remaining ones are completely wasted. The economic loss due to nonutilisation and underutilisation of carcasses and defective flaying etc. has been estimated to be about Rs 50 crores per annum. With a view to making the best use of animal carcasses and inedible slaughter house offals etc., a chain of well equipped carcass utilisation centres should be established by the State Governments throughout the country.

7.9.25 The Municipal Corporations Committees, Gram Panchayats and other local bodies, while giving contracts for lifting the dead animals, should ensure that the contractors have adequate facilities to process the carcasses. Preference should be given to the Animal Husbandry/Industries Departments and Khadi and Village Industries Commission/Banks in the matter of allotment of contracts. In areas where there are hereditary/proprietary rights for lifting the carcasses of fallen animals, Government should construct suitable buildings, provide necessary equipment and facilities to serve as service centres to flayers. The flayers, who bring dead animals, may be permitted to process the carcasses on nominal charges.

7.9.26 Carcass utilisation centres, where more than 4-5 carcasses of large animals are likely to collect daily, should be suitably equipped

for processing the carcasses, and for production of end products like meat meal, bone meal, meat-cum-bone meal under hygienic conditions. Since most of the carcasses are available in rural areas, it is essential to set up flaying and carcass utilisation units through cooperative societies of flayers and panchayats. These units should be linked up with large carcass utilisation centres for reprocessing the end products, where necessary. At places where new slaughter houses are being established or modernisation of the existing ones is taking place, it is necessary to make simultaneous arrangements for establishment of carcass utilisation plants so that inedible slaughter house offals could be processed economically. At present, there is considerable pilferage of fallen animals. The existing Acts of the Municipal Committees, Corporations and Gram Panchayats should be suitably modified to make it obligatory on the part of the owners of the dead animals to hand over the carcasses only to approved carcass utilisation centres. Wide publicity through modern audiovisual methods about the prospects of carcass utilisation programme should be given to arouse awareness among the masses.

FISHERIES

1 INLAND FISHERIES AND AQUACULTURE

8.1.1 India has vast inland water resources spread throughout the country. Inland fish production in India increased from 218,000 tonnes in 1951, to 690,000 tonnes in 1971. The States of West Bengal, Tamil Nadu, Andhra Pradesh, Bihar and Karnataka together contribute as much as 80 per cent of the total annual fish production in the country. Production takes place in fresh water and brackish water resources. The fresh water resources comprise riverine systems, reservoirs, ponds and tanks, ox-bow lakes etc., whereas brackish water resources comprise fisheries in estuaries and lakes and backwaters. Fish production from these inland waters is of great significance because it is capable of making a substantial contribution to the requirements of low-cost animal protein for the people. The source of production is close to the consuming centres, which reduces the cost of distribution. Inland fishes have a high market value and are in great demand and almost the entire catch is directly utilised as human food. Augmenting inland fish production on a priority basis with the application of latest technology, therefore, acquires considerable importance.

Riverine Fisheries

8.1.2 The total length of the main rivers and their tributaries, as computed by the Central Inland Fisheries Research Institute (CIFRI), Barrackpore is about 29,000 km. The riverine systems in the plains are characterised by the occurrence of warm water fisheries and those in the high altitude by cold water fisheries. Indian major carps, *catla*, *rohu* and *mrigal*, are considered to be the most favoured warm water fishes and, therefore, the most important of all fresh water fishes from production aspect. Riverine fishing has, however, assumed importance only in some stretches of the rivers. Estimated production of riverine fish does not exceed 25,000 tonnes. The average catch per fisherman comes to about 150 kg per annum indicating a very low per capita

productivity. Fishing is undertaken by operating different types of gears. The usual practice of fishermen is to resort to nets of smaller meshes to catch even smaller fishes, which adversely affects production in the long run. There is, therefore, a need for controlling such practices by registering the crafts and gears with a view to conserving the fish stocks. The ICAR may take steps for the improvement of fishing gear and their adoption, keeping in view the need for conservation of riverine fish stocks. The fisheries organisations in the States should effectively manage fishing operations in rivers through appropriate regulations to conserve stocks.

8.1.3 The occurrence of major carps has now been recorded in almost all the major peninsular rivers, which were once considered to be completely devoid of these fishes, by the natural process of transplantation. However, in view of the acute shortage of seed fish of major carps their large-scale transplantation in the peninsular rivers is not possible immediately. It would be desirable to pay greater attention to commercially important indigenous fishes of the rivers in peninsular India.

8.1.4 To minimise the adverse effects of river valley projects on inland fisheries, the State Fisheries Department should under-take pre-impoundment studies on riverine fisheries in the planning stages, to provide for regulated discharges for minimising the losses in the downstream fishery of the river. The rivers constitute an important means for the migratory run of the anadromous fish, *Hilsa*, which ascends the rivers from the sea, and yields about 4,000 tonnes per annum in the country. Construction of dams and barrages in its migratory run has had deleterious effects in the past. To stem the rapid decline in *Hilsa* fisheries, particularly in northern rivers, the State Fisheries Department should, in consultation with ICAR, investigate and suggest suitable measures for conservation of this fishery and also enforce restrictions on the operation of such gears as would adversely affect juveniles. Research work on establishing *Hilsa* culture should be intensified by ICAR.

8.1.5 Success in establishing trout fishery in the country was achieved around 1905 in the north in Jammu & Kashmir and Himachal Pradesh and in the south in Munnar High range in Kerala, and Kodai Hills and Nilgiris in Tamil Nadu. In recent years, there have been many improvements in other countries in trout hatchery operations. The hatcheries located at different trout farms in India, however, operate, as of old, without any device for controlling the volume and temperature of water. Traditional feed, both unbalanced and expensive, continues to be given, resulting in a very low rate of survival of the young ones. Improvements in trout hatchery practices should be introduced urgently for higher survival rate, to enable more

intensive stocking of trout streams, and for establishing new fishery areas in Jammu & Kashmir, Himachal Pradesh and other high altitude regions. Breeding and hatchery practices should be developed towards the production of seedfish for undertaking commercial culture in suitable cold water areas.

8.1.6 The *Putitor* mahseer (maximum size 275 cm) occurs all along the Himalayas from Kashmir to Darjeeling Hills. *Tor* mahseer (maximum size 150 cm) is widely distributed along the foothills of the Himalayas and in the Narbada river. Mahanadi variety of *Mosal* mahseer (maximum size 150 cm) is known to occur in the Mahanadi and *Mussallah* mahseer (about 120 cm) in the fresh waters of the peninsular rivers. The fishery of mahseers is important both for commercial and sport fishing. Scientific management and conservation of mahseer fishery resources would go a long way in promoting the tourist industry. Extensive surveys and detailed ecological and biological investigations should be undertaken on different species of mahseers for establishing viable capture and culture fisheries.

8.1.7 Indigenous snow-trout fishery occurring in Himalayas is reported to have suffered after the introduction of mirror carps. The ecology and fishery biology of this fishery should therefore be studied and cultural possibilities explored.

Reservoir Fisheries

8.1.8 Nearly 3 million hectares of waterspread area are available in the reservoirs. The impoundments on rivers bring about an ecological transformation for developing fisheries from riverine habitat to lacustrine or reservoir conditions, with accompanying changes in physical, chemical and biological factors. Hydrobiological surveys of the rivers under impoundment are, therefore, necessary to determine the types of riverine fishery which would thrive in the new reservoir conditions and for preserving downstream ichyofauna. The proposals should be jointly developed by fisheries and irrigation organisations for inclusion in river valley projects and the required works completed before impoundment.

8.1.9 The Indian major carps occupy most important place in reservoir fish production. These fishes should either be the constituents of the indigenous fishery of a reservoir or be stocked therein to enhance production. Stocking of major carps should start right from the first year of an impoundment because the highest phase of plankton productivity is in the initial years. Therefore a seedfish farm for raising fingerlings should be planned as a part of the reservoir project itself. The potential fishing wealth of reservoirs storing water for domestic supply should also be properly utilised but without causing

any deterioration in the quality of water.

8.1.10 Since major carps take a long time in acquiring acclimatisation for natural breeding, adequate level of water in the dead storages of medium and minor reservoirs should be maintained to keep the continuity of acclimatized stocks. Fishing for major carps has to be rationalised by (a) systematic removal of trash fishes and observing closed seasons for breeding and recruitment and stopping indiscriminate killing of brood fish; (b) allowing 3 years after initial stocking before starting fishing in new reservoirs; and (c) spreading the fishing pressure on all size groups. For increasing productivity, fisheries organisations may explore the possibility of growing short duration legumes in foreshore areas of reservoirs exposed in summer months, for being used as green manures. Top cuttings of these crops would be useful as green fodder.

8.1.11 There has been no appreciable change in the field practices in reservoir fishing probably because of the lack of necessary extension work. Necessary extension service should therefore, be organised by holding practical demonstrations on improved fishing gears and bringing out extension literature. With proper management and culture practices, it should be possible to increase reservoir production from the existing 20,000 tonnes to 120,000 tonnes.

Derelict Freshwater Fishery Resources and their Reclamation

8.1.12 The freshwater fishery resources, which have progressively gone into dereliction, comprise the ox-bow lakes, locally known as *mans* in Bihar, *bheels* in West Bengal and Assam and *jheels* in Uttar Pradesh. The extent of derelict freshwater fishery resources is approximately 0.4 million ha, of which about 25 percent or 0.1 million ha could be utilised for the construction of farm ponds. The State Governments should consider these as exclusively fishery resources, while considering the land and water utilisation policy, and other interests, if any, should be deemed to be incidental to the fishery development.

Estuarine Fisheries

8.1.13 The estuaries and backwaters are highly productive areas because of enriched drainage from land and influx of nutrients causing high primary and secondary production. It has been estimated that the estuarine waters have a spread of approximately 2.6 million hectares. Important estuarine resources consist of the estuaries in the Hooghly-Matlah system, Mahanandi system, Godavari system, Tamil Nadu, Chilka lake and Pulicat lake.

8.1.14 The fisheries of brackish water lakes are dependent mainly on ingress and egress of larvae, juveniles and adult fishes and prawns

from the sea. As such, the inflow of fresh water and seawater into the lakes and outflow of brackishwater from them, will have to be so regulated as to maintain the dual interest of improving the fisheries in the lakes and crop production in surrounding agricultural areas. To restore the fall in production from the capture fishery of brackish waters ,it is recommended that the concerned State Governments may formulate proposals for integrated development through a team of technical officers of Irrigation, Agriculture and Fisheries Departments and also undertake necessary investigations on the estuaries within their jurisdiction. The methodology and guidelines developed by ICAR may be followed for adopting necessary conservation and management measures. Regulations for fishery and closed season, if necessary, should be adopted for coastal districts.

Aquaculture

8.1.15 The main role of aquaculture is its contribution to human nutrition, directly as production of food species and indirectly through the production of unicellular algae for use in animal feeds. The most important component of aquaculture practices is the quality of seed of fish and shellfish. Considerable success has already been achieved in producing seed by controlled breeding, spawning, artificial selection and nursing and rearing the young ones of several culturable species. The hatcheries have been modernised by controlling various factors leading to success in culture of trout, salmon and oysters etc. The development of techniques for marketable production of fish and shellfish in fibre glass containers, floating cages and rafts has opened up the possibilities of undertaking intensive aquaculture in a wide range of habitats. In countries like India with low per capita income, the policy of promoting aquaculture should not only lead to increased production, but should also provide maximum employment opportunities. There is need, therefore, for supporting research and development programmes including extension services and extending credit facilities on easy terms ,so that the production base by aquaculture from fresh, brackish and sea waters is enlarged with the application of new technology.

Culture in Freshwaters

8.1.16 Freshwater fish culture in ponds and tanks has been an age-old industry in the country, traditionally practised by empirical methods developed by the fishermen. Fish culture activities for increasing production, however, received real impetus during the Grow-

More Food Campaign and the Five Year Plans. Out of the estimated fresh-water area of about 1.5 million hectares in the country, about 1.0 million hectares had been brought under culture by 1972.

8.1.17 During the last 25 years, several advances in fish cultural practices have been made as a result of researches conducted by the CIFRI. The success in breeding major carps under captive conditions by hypophysation has been an outstanding contribution in the methods of seedfish production. To increase per hectare yield, the CIFRI conducted cultural experiments on major carps by utilising different inputs such as manures, fertilisers and artificial feeds. However, utilisation of inputs with major carps alone in the cultural experiments did not yield the desired results. Experiments were, therefore, undertaken on composite carp culture, combining major carps with three species of exotic carps. In these culture experiments, production rates of about 3,000 and 8,000 kg per ha in case of major carps and composite carps respectively have been obtained with the stocking intensity of about 10,000 fry per ha.

8.1.18 Adequate stocking of the ponds and reservoirs is essential to increase production. The requirements of seed fish (fry) on the basis of stocking rate are estimated at 2000 million for production units below 10 ha and 1100 million for the above 10 ha, making a total of 3100 million fry. In addition, 3,000 million fry would be required for raising into fingerlings for stocking nearly 3 million ha of reservoirs or man made lakes. Further quantities would be required for stocking the resources which would be created in the next 25 years, and for undertaking intensive fish culture. The seedfish supplies of major carps have therefore, to be increased several fold for increasing stocking densities to obtain optimal yields from all culturable waters.

8.1.19 Among the methods for obtaining seed fish in the form of spawn of major carps, viz. riverine source, wet bunds, dry bunds and by hypophysation, the riverine sources contributed about 90 per cent of spawn required to be reared as fry and fingerlings for stocking the culturable resources in the country. But the prospects for any substantial increase in the supply of spawns from the riverine sources do not seem to be good. It has been reported that there has been a fall in the quantity and quality of spawn from some of the established regions. To maintain the spawn wealth in the rivers, such spawn collection centres and breeding grounds of major carps have to be identified and declared as sanctuaries by the respective State Governments. Riverine stretches which harbour large scale concentration of seed fish should be kept only for seed fish collection.

8.1.20 The State Governments should also intensify their investi-

gations to locate as many wet bunds as possible for increasing seed-fish production. The ICAR should undertake detailed investigations in collaboration with the States, where wet bunds are being exploited, to find out the factors responsible for the success of the natural breeding of the major carps in the wet bunds so as to bring about natural breeding in as many stocked perennial waters as possible by providing optimal conditions. Simultaneously, the States should undertake surveys for finding out suitable areas where dry bunds can be constructed with minimum cost—and expand the facilities for dry bund breeding for major carps, as is being done in Madhya Pradesh.

8.1.21 Seedfish farms in the States have a capacity to produce only four per cent of total seedfish production. Considering the advantages of spawn production by hypophysation, it would be advisable to establish as many seedfish farms as possible to attain self-sufficiency within each State. The States should intensify the programme of seedfish production through induced breeding by pituitary injections or other suitable substitutes. As a perennial supply of water to seedfish farm would be an important requisite, location of such farms should preferably be near the medium and major reservoirs, multipurpose projects and drinking water reservoirs. Suitable land for construction of seedfish farms should be made available to Fisheries Departments on preferential basis. To meet the mounting demand of injection material, in the circumstances of shortage of pituitary glands experienced even at the present level of activity, priority consideration should be given by ICAR to the intensification of research on fish gonadotropins at the CIFRI in collaboration with universities and pharmacological laboratories where similar work is being done so as to expedite the process of finding out suitable substitutes. Success in induced breeding method being dependent on favourable environmental factors, the ICAR in coordination with the universities should also intensify studies on the effects of these factors by themselves and in combination with the pituitary extracts with a view to establishing the exact environmental factors necessary.

8.1.22 Fish nurseries in the States are understocked and have mortality resulting in wastage of nursery space and lowered production of fry. The ICAR should organise training and demonstration in fish nursery management for adoption of improved practices in the States and bring out relevant extension literature. Lack of adequate nursery space has been the common experience of almost all the States. It is necessary, therefore, to increase the area of ground nurseries as the activity of seedfish production increases. Floating nurseries can be of considerable advantage wherever adequate space for ground nurseries is not available. ICAR should examine the possibility and economic

feasibility of establishing floating nurseries.

8.1.23 Direct stocking of fry in production units, which are not rendered dry to eradicate predators, has been found to be wasteful. Stocking of fingerlings (instead of fry) is necessary in these units. The States should therefore, give preferential consideration in allocating fallow lands for construction of rearing tanks near such production units. The ICAR should also examine the possibilities of rearing fry to fingerlings in floating net enclosures and make a study of the requisite artificial feeds and the economics of the method.

8.1.24 Of the three species of exotic carps, the common carp has established well in all the States. However, improved methods in rearing and breeding have to be adopted in respect of silver carp and grass carp, the mass production of seedfish of which has been a problem. Besides, the transfer of the technology of cultural practices, being developed at CIFRI, to the farmers will be possible only if a suitable composite fish farm of about 20 ha is set up in each State for adaptive, research and services are organised for analysing soil and water of fish ponds and tanks. Since the use of fertilisers, organic manures and chemical fertilisers, is necessary to increase production, the ICAR should intensify studies on economic uses of different types of fertilisers under different conditions and bring out extensive literature. While setting up a service for soil and water analysis, the State Fisheries Departments should be entrusted with the advisory role on the use of fertilisers also.

8.1.25 The growth rates of major carps based on artificial feeds have so far not been satisfactory. This would require intensification of studies on suitable supplementary feeds in relation to growth coefficients of different species of carps in composite culture. This research would be of equal importance in the culture of brackishwater fishes and prawns. The ICAR should, therefore, step up research on artificial feeds from cheap or waste materials. Introduction of large scale monoculture of common carp in net enclosures kept afloat in reservoirs, canals, etc., seems to be a promising line to be developed in the country. The ICAR should find out the most economical type of enclosures for introduction of this system of carp culture. The fresh water culturable resources available at present have considerable potential for increasing carp production. With the increased stocking density of seedfish of carps in right proportion for optimal utilisation of natural feeds and with the introduction of fertilisers and artificial feeds, wherever intensive culture is economically feasible, the attainment of about 2 million tonnes per annum should be considered as the target in the next 25 years. The States should see that all these water resources are put to maximum utilisation for increasing carp produc-

tion several fold.

8.1.26 Fish culture operation in the existing ponds and tanks have not so far been subjected to economic evaluation and as such there are no reliable published reports on the subject. An analysis of costs and returns, however, shows that carp culture is an economically viable proposition if it is undertaken on an intensive basis with the use of appropriate package of inputs. But in operations depending solely on artificial feeding of stock, as in floating net enclosures, it would be necessary to make large scale use of common carp till such time as suitable artificial feeds are found for major carps. Swampy areas not conducive for carp culture may be increasingly utilised for the culture of air-breathing fishes. Because of their carnivorous nature and habit of lying at the bottom and getting into mud, culture of air breathing fishes is to be preferred in cages for which techniques should be standardised by the ICAR.

Culture in Brackish Waters

8.1.27 The area of coastal saline swamps in the country is about 1.42 million ha, out of which the area under brackish water culture is estimated to be only 12,000 ha. For mapping out areas suitable for brackish water fish farming, the maritime States should undertake detailed surveys of brackish water swamps, and carry out systematic prospecting for brackish water resources for seedfish for fishes like *chanos-chanos*, mullets, pearl-spot and selected species of prawns. The ICAR should develop the methodology to be adopted for undertaking the survey, including the field studies. At present only a small portion of seedfish is collected for brackish water fish culture. There is considerable scope for large scale brackishwater fish culture by proper stocking of selected varieties and use of inputs like organic manures, chemical fertilisers and supplemental feeds.

8.1.28 Mullets are high quality fish and fetch high price. Despite their importance and the scope for their culture by way of availability of seed fish, these resources have been little utilised. Under experimental conditions mullet culture has yielded as much as 2,400 kg/ha in 210 days. With selective stocking and proper inputs, mullet culture can be economically viable. Production can be increased in mullet ponds by combining mullet culture with that of carp in such salinities that are within their thriving range. Mullets have to play an important role in the intensification of fisheries of pulicat and Chilka lakes. Some of these species may prove to be of value in the little Rann of Kutch also. The culture of pearl spot would be of considerable significance in some parts of south India, particularly in Kerala and

and Goa, where it constitutes one of the most highly priced fish. The brackishwater culture with selective stocking can be economically viable. Cultivation of coconut can form a useful and lucrative adjunct to brackishwater fish farming.

8.1.29 The brackishwater systems are spread all along the Indian coast, and each system has its own specific environmental and biological factors. The ICAR and State Fisheries Departments and agricultural universities should, therefore, study, in a coordinated manner, each system separately, as a pre-investment study, by establishing experimental fish farms at suitable centres. These farms should serve as units with a common package approach to all aspects, and investigations should include nursery management practices, economic methods of transport and distribution and research on artificial breeding of mullets and other estuarine species and of prawns in captivity.

Mariculture

8.1.30 Commercial culture of molluscs is an age-old practice in Japan and some of the European countries. In the Indian seas, only four species of edible oysters are known to occur in appreciable quantities with a definite pattern of distribution. Mussels are represented by green mussel (*Mytilus viridis L*) and the brown mussel (*Mytilus sp.*). Edible clams are found in greater abundance than oysters and mussels on both the coasts of India. The maritime States should undertake surveys of coastal regions for locating productive areas for the culture of molluscan shellfish mainly edible oysters, mussels and clams.

8.1.31 The most economical methods of cultivation should be evolved for adoption in the States, for which the ICAR should undertake investigations on different methods of oyster culture. Taking into account the threat to the expansion of oyster culture by heavy pollution effects in coastal areas and estuaries in oyster consuming countries, the possibilities of large scale culture and export of Indian edible oysters should be explored. The mussels culture, with the application of advanced techniques, could be one of the most productive forms of mariculture. Economics of alternative use of mussels for making mussel-meal like fish meal for use as livestock and poultry feed should also be examined. For proper management of clam fishery, resources survey of the areas of availability should be carried out and clam culture by transplantation in suitable areas attempted.

8.1.32 For developing indigenous technology of culture pearl industry and raft-culture of pearly oysters, the Central Marine Fisheries Research Institute (CMFRI) undertook some experiments in 1973.

The successful maintenance of the pearly oysters at Veppalodai in turbid waters at a shallow-depth of 4 metres has indicated the possibility of pearly oyster farming in several places along the coast. In view of this, the ICAR should take up further intensified research in pearly culture through a pilot project with a view to establishing its economic viability and commercial success, particularly off Tamil Nadu and Gujarat coasts, where pearly oyster beds have become unproductive for extraction of natural pearls.

8.1.33 Marine algae or seaweeds are commercially important directly as human food or as livestock feed and fertilisers and indirectly as raw material for industry. In India, seaweeds are available in good quantities only in certain localities such as the Gulf of Mannar, Gulf of Kutch, Chilka lake and around the Andamans and Nicobar, Laskhadweep and other islands. The production of seaweeds, particularly marine algae yielding agar-agar, is not sufficient even to meet the requirements of the existing industrial units. Therefore, there is a need for increased production both in the existing units and those to be established in the next 25 years. For this purpose, corroborative surveys of the sea weed resources should be extended and necessary economic feasibility determined. Culture techniques of marine algae have been considerably developed in Japan. ICAR should bring out the necessary extension literature on the techniques and economics of the culture of marine algae so that the industry can take advantage of the new technology developed by the institutes of the ICAR and CSIR.

Leasing of Fishery Rights in Public Waters

8.1.34 The lease of fishery rights in public waters in different States falls in four categories viz. (a) outright leasing system; (b) royalty system; (c) bifurcated leasing system and; (d) licensing system. The Committee on Leasing Policies on Inland Fisheries (1970) has pointed out the following shortcomings in the present leasing practices :

- (i) poor linkage with developmental needs,
- (ii) short range view of State Governments in ensuring maximum fisheries revenue;
- (iii) leases favouring individuals capable of paying rentals;
- (iv) vested interests of fish merchants in utilising Fishery Co-operative Societies as a means of obtaining preferential leases;
- (v) unauthorised sub-leasing by individuals or Fishery Co-operative Societies in several cases; and
- (vi) handicaps in the effective utilisation of culture fishery

resources owing to the short span of lease periods and absence of the fish farming community.

8.1.35 The primary consideration in granting fishery rights in public waters should hereafter be the long range interest of strengthening the base for increased production, with necessary steps favouring the developmental activities and improving per capita productivity.

8.3.36 The ownership of water resources of the States is at present vested in different departments, namely, Revenue, Irrigation, Fisheries and Forest. For conservation of natural fisheries, their scientific management, promotion of aquaculture and the accountability for the results of developmental activities, the fishery rights of inland water resources including those in the reserve forests should be transferred to the Fisheries Departments. For regulating fishing in rivers, canals, estuaries and backwaters the water areas may be notified under the Indian Fishery Act, 1897 where this has not already been done and licences issued for a period of one year to fishermen cooperative societies or their members or bonafide fishermen. The licensing system would facilitate introduction of suitable restrictions regarding the use of fishing gear, fishing seasons, fishing efforts, protection of brood fish and juveniles, and regulation of spawn collection in spawn bearing stretches. For fishing in reservoirs, *beels*, *mans* and *jheels* also the principles governing the grant of fishery rights should be the same as in the case of other capture fisheries and any system viz. licensing, royalty, bifurcated leasing or outright leasing, may be adopted keeping in view the general principles for conservation and exploitation of resources. However, while granting fishery rights in reservoirs, which require repeated stocking to establish natural breeding, adequate safeguards, as in the case of culture fisheries, should be provided.

8.1.37 Fishery rights in culturable fisheries should be granted as outright lease on adequate tenures to enable utilisation of long term credit. For determining the period of leases, the main consideration should be the quantum of capital investment in relation to period of repayment. The period of leases in such cases should be flexible and need not necessarily be limited to 15 years. There should be a provision for the extension of the lease period on satisfactory fulfilment of the lease conditions and payment of fair rental. For working out the fair amount of rental, the culturable water-spreads may be classified into suitable categories on the basis of estimated fish yield and the price of the produce.

8.1.38 In leasing out fishery rights of the waters belonging to local bodies, such as municipalities and gram panchayats, similar procedure, as for governmental waters, may be adopted. In the case of local bodies interested in undertaking developmental work themselves either

by engaging trained persons or by deputing their own employees for training, the State Governments may accept such schemes as are duly approved by their Fisheries Departments.

8.1.39 In leasing out portions of reservoirs, canals, lakes and coastal waters for intensive aquaculture involving use of floating net enclosures, rafts, cages, etc., same procedure should be adopted as for culture fisheries, except that in the case of reservoirs first preference should be given to persons affected by impoundments after organising them into cooperative societies. In the case of coastal region consideration may also be given to private enterprise including corporate sector.

Organisational Aspects

8.1.40 To enrich the reservoir fishery with the major carps, it is necessary to build up seedfish production capacity of nearly 3,000 million fry (to give 1,500 million fingerlings). An additional 1000 million fry will be required for stocking 0.1 Mha of freshwater swamps to be reclaimed and converted into small farming ponds. About 50 per cent of 4,000 million fry required would, in due course, come from rivers and dry and wet bunds. For the remaining 2,000 million fry, additional capacity of 800 ha of seedfish farms, involving capital investment of Rs. 6 crores will have to be built up. The establishment of freshwater seedfish farms (and also brackish water fish farms in maritime States) would thus constitute the most important function of the State Fisheries Departments. Such farms would also be useful as centres for adaptive research and extension work, particularly for conducting field trials and demonstrations. This activity in districts would justify additional farm staff under a Seedfish Production Officer in charge of the farms.

8.1.41 Aquaculture requires considerable technical assistance in the field of engineering for planning, designing, costing and construction of works relating to seedfish farms etc. An Engineering Cell should, therefore, be set up in the Directorates of Fisheries with requisite technical staff deputed from the Irrigation Department. Absence of adequate work in fisheries extension has been one of the principal reasons for the slow pace of development of inland fisheries.

8.1.42 A shortterm course in extension methods and technology may be organised at the Hyderabad Centre in addition to the long termcourse comprising extension as well as aquaculture. Extension Cells should also be set up in the research and developmental agencies under the Centre and in the Directorates of Fisheries in the States. In the districts having adequate resources of inland fisheries and

aquaculture, there is need for separate extension staff under the district level fishery organisation with facilities for training in the field.

8.1.43 Collective activity being a common feature in inland fisheries and aquaculture this could best be managed under a cooperative system. As such, the cooperatives have an important role to play in the production of inland fish. The concerned departments should work out the minimum scale of economic operations for cooperatives for different fishery activities. The basic consideration should be to examine the possibility of providing adequate means of production to the cooperatives to make them efficient and ensure for each member a level of minimum economic activity to become economically viable. For this purpose, two types of cooperatives—one oriented for capture fisheries and the other for culture fisheries should be set up from the point of view of better management in production activities as also for following the organised programmes of development and application of improved technology. For reorganisation of existing cooperatives or the formation of new cooperatives, the Central Government should frame separate model bye-laws for the two types of cooperatives keeping in view the respective emphasis on the aims and objectives of capture and culture fisheries. Marketing the catch by the members through cooperatives should, however, be obligatory in both cases. The necessary working funds should be made available to the marketing cooperatives by the cooperative banks or the Government so that they make immediate payment to producers.

8.1.44 Development of inland fisheries and aquaculture has large potential for employment at the production level. It is estimated that a production of 2,000 kgs of primary variety of culturable fish in a year will yield an income of Rs 2500 to maintain a family above the desired minimum level of consumption. On this basis, production of about 2.8 million tonnes from culture fisheries of the existing ponds and tanks and new farming units to be reclaimed should provide employment to about 1.4 million employment units (families) by 2000 AD.

2 MARINE FISHERIES

8.2.1 Sea fishing, as an occupation with the coastal people of India, has been an integral part of the country's maritime heritage. Through the industry had reached a high degree of viability by the time of Independence as a result of indigenous techniques evolved by the marine fishermen, India's progress, in comparision with advanced maritime countries was tardy. A meaningful move towards a modernised marine fishing industry was made since Independence with accent on

research and mechanisation. The basic need for providing research support to the industry was fulfilled by establishing the Deep Sea Fishing Station at Bombay in 1946, the Central Marine Fisheries Research Institute (CMFRI) at Mandapam in 1947 and the Central Institute of Fisheries Technology (CIFT) at Cochin in 1957, each having respective field stations at selected centres along the coast. The Central Institute of Fisheries Operatives (CIFO) was established at Cochin in 1963 for giving organised institutional training to operatives at various levels of skills, particularly for manning the larger fishing vessels requiring registration under Merchants Shipping Act. (1958) The Marine Products Export Promotion Council was set up in 1961, which was reorganised as the Marine Products Export Development Authority in 1972. The salient features of development of the fishing industry were the addition to mechanised fishing fleet, use of synthetic fibres, use of materials indigenously manufactured for fabrication of fishing gears and introduction of bottom trawling. A marked advance was also made in the processing sector. The progress after Independence has raised the status of the industry as a promising area of growth, thereby attracting capital and management from both individuals and the corporate sector. The developments in the industry have, however, been concentrated on aspects pertaining to exploitation of stocks of inshore fisheries adjacent to the coast.

Production Trends

8.2.2 The world marine fish production had increased to 60.9 million tonnes in 1970 compared to 15.4 million tonnes in 1950 registering a growth rate of 15 per cent. In India, marine fishery production increased from 0.58 million tonnes in 1950 to 1.16 million tonnes in 1971 with an average annual growth rate of about 5 per cent. This accounts for about 40 per cent of the Indian ocean fish production. There were considerable variations in the magnitude of marine fish production during 1951-72. The marine fisheries of India are characterised by the presence of a large number of species. For determining the trends in production in the constituent fisheries, the CMFRI has classified them into 37 groups, each containing one or more species.

8.2.3 Taking into account the quantity of catches, the oil sardine (*Sardinella longiceps* Val.) is the most important marine fish, exploited between Quilon (Kerala) and Ratnagiri (Maharashtra) and contributing 23-24 per cent of the total landings in India. But the annual catches widely fluctuate. The fish is mainly caught by boat-seines and gill nets in Kerala, and by shore-seines and gill nets in Karnataka.

Where the oil sardine spawns, wherefrom it comes in the inshore waters to constitute this fishery and where it goes after the fishing season are little known. Another important fishery is the Indian mackerel (*Rastrelliger kanagurta Cuv.*) It occurs along both the coasts contributing 8.2 per cent to the total marine fish catch. The Bombay duck (*Harpodon nehereus Ham.*) contributes on an average 8.3 per cent to the total catch. It constitutes a major fishery along the northwest coast with Maharashtra (35.3 per cent) and Gujarat (62.8 per cent) together contributing 98 per cent. The fisheries of lesser sardines mainly in Tamil Nadu, Andhra Pradesh and Kerala contribute about 5.0 per cent. The Elasmobranchs, comprising several species of sharks, skates and rays, constitute an important group of large sized fishes occurring all along the coastline of India; their average annual production forms about 4.1 per cent of the total marine fish landings. The Silver Bellies, mainly available along the coastline of Tamil Nadu, Andhra Pradesh and Kerala contribute about 3.8 per cent while Ribbon fishes contribute about 3.6 per cent. The catch of Sciaenids comprises about 3.3 per cent and the contribution of catfishes is also of the same order. Pomfrets, which have a large demand in the country, contribute about 2.3 per cent of the catch. They are caught all along the east and west coasts, but the landings in Gujarat and Maharashtra account for the bulk of the catch of these fishes. Seer-fishes and perches form about 1.4 per cent and 1.1 per cent respectively of the total catch. The catch of all the polynemids averages about 4,300 tonnes per annum contributing only 0.5 per cent. Tunas and Skipjacks are economically important fishery, but the catch of tuna and tuna like fishes is insignificant at present—comprising only 4,000 tonnes or about 0.5 per cent. The geographical position of India, however, offers considerable advantage for the development of high seas fishing for oceanic tuna. The other miscellaneous fishes contribute nearly 3.0 per cent of the total landings.

Resource Potential, Survey and Assessment

8.2.4 It has been estimated that the continental shelf of India has a potential of 2.4 million tonnes comprising 0.7 million tonnes from demersal fisheries and 1.7 million tonnes from pelagic fisheries. The extensive resources beyond the continental shelf hold additional potential for increasing production from conventional and nonconventional types of fisheries, comprising high seas tuna, deep sea fishes, oceanic cephalpods particularly squids and deep sea crustaceans. Besides, there are the underexploited molluscan resources in the continental shelf, particularly the oysters, mussels and clams. Considering all

these potentials, the production of marine fish, excluding mariculture, should be increased from the present average of about 1.0 million tonnes per annum to at least 3.5 million tonnes per annum after 25 years. The fisheries survey is mainly conducted by the Deep Sea Fishing Organisation (DSFO), which was established in 1946. It has eleven bases and a fleet of 30 vessels; but due to inadequate utilisation of the vessels, it had covered only about 48,000 sq km mainly within the depth of 60 m, out of the total area of about 415,000 sq km of the continental shelf. The survey work so far conducted has indicated that most productive trawling grounds in terms of both quantity and quality are in the north west coast of India, bordering Gujarat and Maharashtra States upto about 75 m depth. This area has a potential of yielding an additional 400,000 tonnes from demersal fisheries.

8.2.5 Under the Indo-Norwegian Project, renamed as the Integrated Fisheries Project systematic exploratory fishing has been carried out with larger vessels along the south west coast of India. The survey has indicated good quantities of the perches (*kalva*) and the rock cod (*velameen*) between Mangalore and Quilon, fairly productive trawling grounds and also deep water crab resources. Abundance of bathypelagic fishes and larger species of sharks and fairly rich grounds of deep sea prawns and lobsters, particularly in the area lying south west of Quilon were also located. Another important finding was the abundance of oceanic squids, particularly *symplectoteuthis ovalaniensis*. The United Nations Development Fund (UNDF) Pelagic Fisheries Project has formulated preliminary estimates of oil sardine and mackerel resources at 0.40 million and 0.45 million tonnes respectively, which are subject to confirmation by further assessment studies. The Project has also identified resources of white bait, *Anchoviella* spp., horse-mackerel and semi-pelagic fishes called 'shallow-water mix'. In the light of the resources survey and assessment of pelagic fisheries beyond the traditional zone of exploitation along the coast of Karnataka and Kerala, the strategy for exploiting this additional resource should be developed as early as possible, without, however, affecting the exploitation of this fishery in the traditional zone by the existing fishing methods.

8.2.6 A few exploratory surveys conducted in the Wadge Bank lying beyond the southern tip of peninsular India have proved the richness of this region for demersal fishes, particularly perches. Organic productivity studies indicate a potential of 25,000 tonnes per annum as against the present catch of about 2,000 tonnes. The State Governments of Kerala and Tamil Nadu should formulate specific schemes for stepping up production from Wadge Bank fisheries, particularly by

developing fishing effort by mechanised fishing boats from Tuticorin and Vizhinjam.

8.2.7 The CMFRI has one regional centre, nine substations, three research units and 26 survey units. The CIFT has three sub-stations and four research units. Research work done at the CMFRI has so far centred mainly around the biologically-oriented problems and not much work has been done on advancing knowledge concerning the effects of environmental conditions on different types of fisheries. In a larger perspective, the National Institute of Oceanography (NIO) has been conducting research on the environmental aspects of the living resources. In view of the importance of studies on determining distribution and densities of different types of fish populations in space and time and correlating these with environmental parameters, the CMFRI, in coordination with NIO, should lay greater emphasis, in its future programmes of research, on the effects of environmental factors on different types of fisheries. At the CIFT, research work on craft and gear has helped the mechanisation programme gain momentum. However, research studies on behavioural systems of different fish populations to gear and craft has been lacking. In its processing division, studies are being conducted on the fundamental aspects of fish biochemistry and microbiology. Formulation and standardisation of methods for processing fishery products and byproducts are also undertaken.

8.2.8 There is a considerable gap in the marine resources survey and assessment in bottom trawling. Pelagic fishery investigations have been taken only with reference to oil sardine and mackerel. There have hardly been any investigations regarding gillnet fishery or for the introduction of midwater trawling. Even proven grounuds are not being put to economic utilisation. This points to the need for the public sector to give a lead to the industry.

8.2.9 The two aspects of resource survey and assessment, viz, prospecting of new or under-utilised stocks of fish and monitoring for maintaining the stocks at the optimum sustainable yield, require multidisciplinary activity and an integrated approach as a prerequisite to further expansion of marine fisheries. A research fleet comprising a fewer number but well equipped vessels would be more effective in giving the required scientific information than the wasteful continuance of the vessel-effort with a large number of vessels merely engaged in a repetitive type of exploratory and experimental fishing. It may be desirable to restructure the DSFO and the IFP into one unit as Marine Fisheries Development Organisation or Corporation, with considerable autonomy in operations.

8.2.10 Unit of the DSFO rendered surplus as a result of this inte-

gration should be wound up or transferred to State Governments or Corporations wishing to run them on a commercial basis. Useless vessels of these organisations should be scrapped and the remaining vessels regrouped into two fleets : (a) a research fleet for survey and assessment to be directed by the research agencies of the ICAR and (b) a fishing fleet for experimental and commercial fishing to be handled by the proposed Marine Fisheries Development Organisation. All the vessels should be maintained for top level performance and available for providing seatime to the fishing operators being trained and qualified for various certificates.

8.2.11 The resources survey and assessment being a research function should be the responsibility of ICAR, through the CMFRI, in co-ordination with CIFT, NIO and other Central and State fisheries organisations. The combined leadership of the programme may be vested in a senior scientist to be nominated by the ICAR from any one of these organisations, but with unambiguous delegated authority for framing and execution of survey and assessment programmes. A well-equipped research fleet to be maintained and operated from selected centres should be available for this purpose and the ICAR should see that prevailing rules and procedures for their maintenance do not constitute a constraint in the progress of work.

8.2.12 In India only old admiralty charts are available to the fishing industry for navigational purposes, thereby indicating a need for preparing fishery charts to enable the fishermen to develop correct strategy for planning fishery trips. A revised set of Indian Hydrographic charts, being brought out by the Indian Navy, will be useful. However, it is necessary to have a centralised agency for collecting the information already available with various agencies on fishing grounds, environmental and oceanographic features etc., and for preparation of fishery charts. The Ministry of Agriculture and Irrigation should set up a working machinery, in coordination with Chief Civil Hydrographic Office, NIO, CMFRI and Marine Biological Fisheries Research Organisation for preparation of fishery charts.

8.2.13 The means of production from coastal and offshore fisheries in India are (a) non-mechanised boats; (b) mechanised crafts; and (c) bigger vessels made of steel. The non-mechanised crafts consist of catamarans, masula boats and carvel boats on the east coast and of dugout canoes and built-up boats on the west coast. The fleet of non-mechanised boats is still of considerable importance as it contributes annually as much as about 0.7 million tonnes of marine fish production with an average of about 6.0 tonnes per craft per annum.

8.2.14 The initial step in the programme of developing mechanised fishing fleet of India was motorisation of existing traditional craft,

which was followed by introduction of newer designs of fishing boats. The programme of mechanisation of fishing craft has been the most significant aspect of development in the means of production. But the rate of mechanisation was not adequate against the decommissioning of boats after service. The decommissioning of mechanised boats without replacement would cause gradual decrease in the effective strength of the fleet, bringing about a serious situation in the means of production. The non-replacement is due mainly to the escalated cost of mechanised boats. The programme of mechanisation has not made any significant progress in some States. The level of subsidies are, however, being progressively scaled down everywhere. In the absence of repeat subsidy to the fishermen for replacement of unserviceable mechanised boats, the State Governments should institute a system of preferential loans for boat and/or engine replacement and ensure that withdrawal of subsidies does not affect the progress of introducing mechanised boats in the areas having scope for mechanisation.

8.2.15 The Ministry of Agriculture and Irrigation has so far been following the policy of introduction of steel trawlers for the development of offshore or middle distance fisheries. In the first phase, emphasis was on construction of 40 vessels indigenously. The performance of these vessels had, however, many defects, causing considerable operational difficulties. For development of the industry for construction of fishing vessels on proper lines, the fabrication of fishing vessels with steel hulls in the country should be limited to those ship-building yards, which are willing to specialise in fishing vessels, execute the orders in reasonable time and accept responsibility for satisfactory working of the complete vessels including design, fabrication, equipment and its repair and maintenance. By specialisation, these yards could also develop facilities to improve the design and equipment, thereby making construction more economical and operation more efficient.

8.2.16 An import of 30 vessels was allowed in 1968 in the second phase, and of 50 vessels in the third phase in 1973, with a view to accelerating the pace of development of offshore fisheries. The Government has thus taken more than adequate steps in importing larger trawlers, and further import of such trawlers beyond the numbers which have already been ordered should be done only after careful consideration. However, the import of prototypes should be allowed or even encouraged as this would help the indigenous fishing vessel construction industry. The CIFT should strengthen its craft and gear section with personnel qualified in naval architecture for developing designs to suit Indian conditions.

8.2.17 There is a tendency on the part of larger vessels to direct

fishing effort towards catching prawns as the best economic commodity. Since the presently known resources of prawns of exportable quality (excluding deep sea prawns) have almost reached the maximum sustainable yield, there have been reports of conflict between the non-mechanised boats, mechanised craft and larger vessels. Government should therefore, take necessary measures for delimitation of fishing zones through legislation, with necessary provisions to avoid the possibility of any conflict in future.

8.2.18 The larger vessels also find it more economical to process or preserve only a portion of the catch constituting prawns and some prime fishes, whereas the rest of the catch comprising lesser varieties is thrown overboard. This is a wasteful practice. The practice of discarding the trash fish overboard should be curbed, and the possibility of installation of 'pocket' size fishmeal plants may be examined. Further, it should be made obligatory for all the vessels above 25 GRT to report the catch in terms of quantity and quality to CMFRI.

8.2.19 Wood and steel have long been in use all over the world for fabrication of fishing craft. In the last thirty years, however, some new materials viz, fibre glass re-inforced plastic (FRP), aluminium alloy and ferro-concrete, have been increasingly introduced. Having regard to the increasing difficulty in obtaining large logs of suitable type in sufficient numbers to meet the replacement needs of the fishing boats, the CIFT should study the use of FRP for mass assembly for smaller craft, particularly for canoes and catamarans. In the light of the comparative features of different hull materials, the CIFT should examine in detail the technical aspects and economic advantages of different hull materials for construction of fishing boats, and evolve a clear categorisation of the craft and the material to be used to give the most economic results. Wider trials of ferro-concrete craft should also be made.

8.2.20 The programme of mechanisation of fishing fleet, in the initial stages, depended on imported engines. With the increasing manufacture of indigenous engines, the imports had to be eventually stopped. To ensure high quality and excellent performance of indigenous engines, the CIFT should work out necessary standards, in consultation with ISI, for certifying the quality of engines. There should be a reasonable guarantee period and manufacturers should develop adequate repair facilities at important fishing centres so that fishermen do not lose fishing time due to engine breakdowns.

8.2.21 The prevailing prices of indigenous engines are very high. Government should examined the possibility of bringing down the cost by (a) examining the price structure so that there is no undue profitability (b) limiting the manufacture to a reduced number of indus-

trial units; and (c) by giving relief in sales tax and excise duty.

8.2.22 There are a number of different types of traditional gear indigenously developed by the fishermen for exploiting different types of fisheries. Some of the important fishing gears used for commercial fishing in India are : (a) gillnets and entangling nets; (b) shore-seines and boat-seines; (c) stationary bagnets; and (d) hook and lines, namely, handlines, long-lines, pole and line and trolling lines. The fishermen have for generations confined themselves to the operation of the same type of gear. The desirability of making improvements in the use of fishing gear to make them more productive and economical cannot be overemphasised. The craft and gear section of the CIFT and the fisheries research organisations in the maritime States should intensify research in coordination, on the traditional gear systems with a view to bringing about improvements in per capita productivity and economic returns to the marine fishermen.

8.2.23 Several methods are in use at present for exploiting demersal and pelagic fisheries. Bottom trawling with a pair of otter boards and its other variations is generally used for exploitation of demersal fisheries, midwater trawling for commercial fishing of midwater and semi-pelagic fisheries, and purse-seining for pelagic fisheries. The underlying idea in extending the trawling operations to midwaters and semi-pelagic zone and purse-seining from pelagic to midwaters by using very large and deep nets, was mainly to bring in intensive methods of production in capture fishing technology replacing less productive methods. The studies on the introduction of these new types of fishing methods should be intensified, as most of the Indian fishery resources are pelagic, semipelagic midwater, and epibenthic, seeking foreign expertise, wherever necessary.

8.2.24 The CIFT along with Fisheries Departments of maritime States should strengthen their extension services and demonstrate the economic advantages of various types of modern fishing devices, particularly fish finders/echo sounders and deck equipment for the operation of different types of gear. The CIFT should liaise with the electronic industry to develop and market in the country a robust and versatile echo sounder for the smaller mechanised craft and trawlers. The instruments and deck machinery required, and now manufactured in India, should be standardised through the cooperation of the CIFT and ISI keeping in view the need for reducing the number of items and their specifications, and the need for inter-changeability of equipment.

Tuna Fishing in the High Seas

8.2.25 In the Atlantic and Pacific oceans, fishing effort is largely

oriented towards oceanic tuna, whereas in the Indian ocean greater effort has so far been towards other tuna and allied fishes. Further, the catch of oceanic tuna in the Indian ocean is almost exclusively taken by Japan, Taiwan and Korea, and hardly any catch is being landed by the countries bordering on the Indian Ocean. From the mainland of India, no fishing effort, exclusively for oceanic tuna, is now being undertaken. However, exploratory fishing for these tuna, by longlining was conducted during 1963-65 with the help of FAO expert, off the south-west coast of India. The investigations showed that the catch composition, by weight, comprised 70 per cent sharks, 15 per cent tuna, mainly yellowfin and big eye, and 15 per cent spear-fish and others. The only organised fishing for oceanic tuna mainly skipjack, is being conducted in the near shore waters of the Lakshadweep islands.

8.2.26 With considerable prospects of increasing export earnings from the products of oceanic tuna, India should make an early entry into the commercial fishing for high seas tuna in the Indian ocean. This would also enable India to have more effective participation in the International management of the high seas tuna resources in the Indian ocean. The commercial ventures could be started right away since it is known that the resources are already being exploited by other countries. The process of developing expertise could be accelerated if foreign expertise were to be associated with interested sectors of Indian private industry or the proposed Marine Fisheries Development Organisation. Also the exploitation of skipjack fishery resources in the Indian ocean, particularly around the Indian islands, should be given special attention in the development of high seas fishing for tuna.

Fishery Harbours

8.2.27 The need for providing landing and berthing facilities for small mechanised fishing boats was first felt during the Second Plan, by which time the mechanisation programme had gained momentum. The investigations for and formulation of the projects for fishery harbours and their execution at major commercial ports were undertaken by the respective Port Trust Authorities. For small ports, the Government of India and FAO as an executing and participating agency of UNDP, jointly set up Pre-Investment Survey of Fishing Harbours Project (PISFHP) at Bangalore in 1968 for preparing techno-economic project reports for full fledged fishing harbours at different centres on both east and west coasts. For accelerating the provision of harbour facilities at landing sites in each maritime State, a comprehensive report

on planning of minor harbour works should be prepared as expeditiously as possible. First priority should be given to the construction of essential works for giving an early relief to the industry. Provision of a slipway should be made at each self-contained harbour.

8.2.28 The PISFHP has so far been responsible only for formulating the projects for the development of fishery harbours. Most of the harbour projects at present suffer for want of a suitable organisation which would lend technical expertise for executing the projects with a time bound programme. The Government of India, in consultation with the maritime States, may work out a scheme for reorganising the Project, so as to make it responsible not only for formulation of the projects but also for speedy execution of harbour works. The project reports in respect of 20 sites already investigated, when finalised, should be executed before taking up any new investigation.

8.2.29 Because of the physical characteristics of the Indian coastline, initial dredging work has to be undertaken at many of the harbour sites. Making adequate provision for the execution of dredging works would, therefore, be an important item in the execution of fishery harbour works. Since it has been suggested that the PISFHP should have the responsibility for execution, the same organisation should estimate the requirement of dredging works and procure necessary dredgers, as a central pool, for the construction of fishery harbours. By doing so, it would be fully concerned with the planning, designing and execution of fishing harbours on a time bound programme. Maintenance of fishery harbours will, however, be the responsibility of the State Governments. Suitable machinery should be set up by the State Governments for their proper management and maintenance as well as for levy and collection of port dues and other charges.

8.2.30 The procedures for sanctioning fishery harbour projects by the Government of India should be streamlined to avoid undue delays which have resulted in several cases, in the revision of estimates, only projects with up to date estimates may be processed for sanction and necessary funds made available for their execution. For expediting the construction of fishery harbours, the following measures may be taken :

- (i) The State Governments and port trust authorities should make available the required land as soon as the project is cleared;
- (ii) port trust authorities should make a survey of the equipment available locally, so that when the work is tendered, there is sufficient response; and
- (iii) the Chairman of the concerned Port Trust Authority should be given full powers to invite tenders, select the contractor and execute the work within the approved ceiling without

having to obtain approval of the Government.

2.3.31 Till the fishing harbours are ready, facilities for operation of larger fishing vessels should be provided at commercial ports. The Centre and State Governments should formulate specific schemes for expansion of fishing efforts from the prospective fishery harbours, and fix the base of operation for new vessels from different harbours as and when they are commissioned. To make the fishery harbours fully functional at the time of their commissioning, provision of facilities such as roads, processing plants, water supply, electricity etc. by the State Governments should be synchronised with the construction of fishing harbours.

Training of Operatives

8.2.32 There are 27 training centres in the maritime States and Union Territories for training operatives for small mechanised fishing boats. Fishing vessels which do not exceed 25 tonnes gross, not covered by Indian Merchant Shipping Act, 1958 are registered under Acts which do not entitle them for fishing outside harbour limits, thereby putting the operatives to considerable difficulties. The port authorities do not recognise the certificate issued by the State Directorate of Fisheries or CIFO. The rules for navigation, registration and manning of vessels of 25 tonnes gross or below should be framed expeditiously by the Directorate General of Shipping for uniform application in all maritime States, taking into consideration the specific conditions of the fishing industry. The rules should cover recognition of the certificates issued by the State Directorates of Fisheries or CIFO for operating the vessels outside the harbour limits. A uniform pattern of syllabus and examination rules at the Fishermen Training Centers for awarding the certificates should be worked out jointly by the maritime States and the Centre, in consultation with the Director General of Shipping.

8.2.33 The fisheries organisations in the States should take steps to enable fishermen training centres to assume the additional function of developing necessary liaison with fishermen and building up extension services in their respective regions with a view to improving their working systems. The grant of remissions in sea time/workshop time, being given at present as a matter of discretion by the Mercantile Marine Department to the institutional trainees should be adopted as a general rule applicable to all trainees sponsored for examination by approved institutions. All rules and regulations pertaining to registration, navigation, manning and examination with reference to fishing vessels, should constitute a separate Chapter in the Indian Merchant

shipping Act, and a separate booklet should be brought out for the use and guidance of the fishing industry. The candidates preparing for Fishing Secondhands and Skipper's Certificates should first qualify for a Proficiency Certificate in fishing to be awarded under the authority of the Ministry of Agriculture & Irrigation, before they are allowed to appear for the examination of respective Competency Certificates held by the Mercantile Marine Department, mainly in the disciplines of navigation and seamanship. The present system of institutional training should further be modified in such a way that the institutional candidates for Fishing Secondhand and Engine Driver Courses gain the qualifying sea time/workshop time in between the institutional training, so that they can directly appear for Competency Certificates. Training in radio Telephone equipment should also be included in the syllabus for Fishing Secondhands.

8.3.34 Planning for integrated development of marine fishing industry by introducing larger fishing vessels should give due consideration to the availability of skippers. As it takes at least five years for skippers to qualify, it is necessary to formulate developmental plans for the introduction of larger fishing vessels in advance so that there should be no difficulty regarding the availability of skippers. At the same time, to guard against unemployment among trained personnel, necessary incentives should be provided whenever necessary for self-employment by enabling them to acquire small mechanised fishing boats.

8.2.35 The utilisation of the intake capacity of inshore technicians course has been between 30 and 50 per cent. Appropriate steps should be taken to justify the continuance of these courses. Utilisation of the capacity for the teacher training course has been below 25 per cent. The States should encourage deputation of teachers to this course in the interest of making their fishermen training centres more efficient.

Economic Aspects

8.2.36 In the absence of studies on the cost and return functions of different fishing methods and on the economic status of the fishermen in different maritime States, necessary studies should be jointly undertaken by the State fisheries organisations and Bureaus of Economics and Statistics, for subsequent review at the Centre, for planning developmental programmes and determining their economic impact.

8.2.37 To involve small and marginal marine fishermen in the production process, the feasibility of organising cooperatives of the type of Farmers' Service Societies should be examined by the maritime

States. To begin with, each maritime State may set up two or three societies on a pilot basis in areas where the fishing community operates primarily as small units of production. The maritime States should also undertake a comprehensive review of the existing marine fisheries cooperatives with a view to assessing the type of assistance needed, managerial or financial, to bolster the uneconomic units and make them viable. The feasibility of reorganising the non viable units on the lines of the Farmers' Services Societies should also be examined. The cooperative societies should perform the additional function of mobilising savings considered necessary for consumption by fishermen during the period of cessation of fishing in monsoon so as to save them from exploitation by the middlemen.

8.2.38 At present, subsidy is given at about 27½ percent on construction of indigenous steel vessels larger than 17.4 m. The Government of India should suitably modify the subsidy scheme so as to cover fishing vessels of all types of hull material and of adequate size to undertake fishing in offshore waters, with a minimum endurance capacity of remaining at sea for more than 72 hours. For expanding fishing effort for exploitation of offshore and deep sea fisheries, there is need for giving a reasonable incentive support to the industry, which should not be linked with export performance. The preferential loans, with grace periods and low interest, should therefore, be granted to accelerate the development in the initial stages. The loans may be channelised through the public sector fisheries corporations in case of vessels up to 25 GRT and through Marine Products Export Development Authority in case of vessels above 25 GRT. These organisations should serve as specialised fisheries agencies for financial assistance to look after the specific needs of the fishing industry. The concession on diesel oil duty should be extended to all sizes of mechanised fishing craft, because oil costs have reached prohibitive limits. A high level committee should be set up to go into the question of diesel oil concessions to fishing industry as a standing machinery to regulate the retail cost of diesel oil.

8.2.39 Insurance coverage of the entire value of mechanised boats should also be fostered by the LIC in coordination with the State fisheries organisations. Instead of charging variable rates of insurance premia, as at present, for mechanised boats operating in different States, the LIC should examine the adoption of uniform rates tenable throughout the country, with necessary surcharge for boats without monsoon lay up.

Marine Fishery Policy

8.2.40 A large scale development of marine fisheries involving
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heavy investment and offering vast economic potentialities should be guided by a clear and far sighted policy. Marine fishery policy should, therefore, be recast in the light of the exclusive fishery zone adjacent to the coast. Fishing effort of the future will be concentrated in an intensive manner in the superjacent waters of the Indian continental shelf and the waters outside the shelf but within the 320 km limit. The fishing fleet development, which is closely linked to the magnitude of operations, the size of vessels, training of the crew, supporting industries etc., has to take cognisance of the new realities of the situation. The pattern of deep sea fishing should, therefore, be in favour of middle distance fishing fleet and medium sized vessels rather than large vessels capable of operation for long distances and long absences from the base.

8.2.41 The economic zone adjoining the coast will, in future, be the area of intense activity in fishing, mineral exploration, defence and navigational installations, oil drilling and coastal aquaculture. Such intense development can lead to conflicting interests and damage to living resources. These activities should, therefore, be coordinated at the highest level involving the National Environmental Committee, the proposed Ocean Science and Technology Agency and the maritime States.

8.2.42 In the development and utilisation of the exclusive fishery zone, the maritime States should play a responsible part. While the initiative for legislative measures on marine fisheries would stem from the Centre based on research findings, these would be enforced more appropriately through State agencies. Adaptive research in the field of aquaculture and utilisation of coastal resources through the transplantation of new species, introduction of new craft and techniques of capture and culture also form a field in which the State Governments should play a more positive role.

8.2.43 As regards scientific research on fish stocks and related problems, the ICAR should ensure the fullest development of research facilities, expertise and opportunities for cooperation with neighbouring countries, enabling India to have the most up-to-date information on the fish stocks around the country.

3 CRUSTACEAN FISHERIES AND THEIR UTILISATION

8.3.1 Among the marine fisheries of the country the crustaceans comprising prawns, lobsters and crabs, are by far the most important in terms of value of the catches. Although they form about 15 per cent of the landed wet weight of the marine catch, their value exceeds

60 per cent of the total. The development of export trade of these resources has been so rapid that problems concerning their conservation and management have not been fully appreciated and need special assessment.

Prawn Fisheries

8.3.2 The prawn fishery of the country is mainly supported by littoral forms and are distributed all along the 5,600 km coastline. Of the estimated 415,000 sq km area of continental shelf, only about 112,000 sq km is exploited at present. The majority of the species exploited are marine, most of them with an estuarine phase with a small number in estuarine and fresh water. The existing prawn fishery is generally restricted to the shoreward side of the continental shelf, and production of deep water prawns does not exceed 100 tonnes per annum.

8.3.3 For exploitation of prawns in creeks and shore waters, smaller craft (5 to 6 m) with outboard engines will be suitable. Production of outboard engines suitable for this may be taken up within the country. The 9.6 m mechanised vessels with 40 BHP engine is considered suitable for replacing the presently used indigenous craft in the coastal waters, and as such their increased production within the country should be encouraged. One of the essential needs of the prawns fishing industry is the acquisition of bigger fishing craft of more than 17 m to fish in deeper regions of sea, which need not come to the shore every day. While construction of such boats in the country is to be encouraged, import of some prototypes should also be allowed so that the quality of the indigenously manufactured vessels can be maintained and improved. Systematic data on the crustacean landings are available from 1950 under three broad categories, viz., (a) penaeid prawns, (b) non penaeid prawns; and (c) other crustaceans comprising lobsters and crabs. There has been a large increase in the crustaceans catches between 1960 (71,000 tonnes) and 1974 (183,000 tonnes), though subject to normal fluctuations. Over 50 per cent of the all India landings of penaeid prawns are obtained from Kerala. In 1973, the penaeid prawn catches were exceptionally high in all the States except Maharashtra and Tamil Nadu. The rise in the catches of penaeid prawns is mainly due to the introduction of mechanised boats/trawlers.

8.3.4 The depth wise distribution of prawns as observed by exploratory vessels at three depth zones, viz., 0-40m, 41-80m and 81m and above shows considerable variance. A significant discovery is, however, the location of rich grounds along the continental slope of

south west coast of India for deep water prawns. On the east coast information on the prawn population from the deeper grounds greater than 40 m depth is scanty. Detailed information on the depthwise distribution of prawns is essential for judicious exploitation of the stock. The results so far obtained from the operations of the exploratory vessels are patchy and leave much to be desired. The ICAR coordinated project on marine prawn biology and resources aimed only at quantitative work and was in existence for a brief period of 2½ years only. In spite of the development that has taken place in the industry, no effort has been made to draw up a national programme of prawn resources survey for obtaining year-round quantitative information for all fishable areas around the country. Such a survey should be conducted on top priority basis by making use of the existing vessels under the Government agencies.

8.3.5 The general biology of the prawns is characterised by high fecundity, fast rate of growth, continuous breeding and short span of life. Therefore, the nature of the fishery is somewhat like that of an annual crop, the success or failure of which is largely determined by the strength of recruits from the successive spawning. The wide fluctuations observed in the catches in certain years in some of the regions can only be due to fishery independent factors; for the same reasons, the apprehension about the depletionary tendencies in prawn fishery does not seem to be well founded. A detailed estimate of the stock of prawns in Kerala region has shown that the fishing effort in this region has come to a level from where further increase is likely to reduce the catch per unit of effort. For accurate assessment of the effect of exploitation on the available stock, strictly comparable data on the landings of major species separately are necessary. The CMFRI should take steps to collect these data separately from different centres for the major exploited species as data on gross basis for composite groups are not suitable for studying the effects of exploitation. It should also collect data of the juvenile prawn fisheries in the estuaries which are essential for an understanding of the prawn resources in the proper perspective for management purposes.

8.3.6 By judicious development of capture fishery and by exploitation of new fishing grounds, it should be possible to obtain an overall crustacean catch of 400,000 to 500,000 tonnes against the present catch of 183,000 tonnes per year. Culture of prawns also has vast possibilities, as major species of prawns available in the country are suitable for cultivation in the brackishwater areas. The establishment of model farms in different localities and undertaking of extension work will create the appropriate climate for prawns cultivation. As these schemes are associated with the development of the rural economy, top

priority should be given for such schemes and institutional finance provided for them.

8.3.7 The fresh-water prawn fishery in the country is at present of minor character. However, as there are some excellent species for fresh water culture, efforts for their culture in rural areas should be encouraged.

8.3.8 The Indian Fisheries Act, 1897 was passed at a time when fishing activity in the country was insignificant. The capture fishery has progressed from subsistence fishery to an organised industry. It is now necessary to enact a new fisheries act to regulate all aspects of fisheries activities, particularly prawn fisheries and ancillary industries on all-India basis. The State fisheries organisations should institute a system of categorising and registering fishing boats engaged in prawn fishing with reference to operational bases and areas of fishing. Further, suitable regulatory measures should be introduced in appropriate areas to protect the stock which should be regularly monitored by the CMFRI. The CIFT should also take up the problem of processing smaller prawns for export and for internal consumption and evolve suitable processing techniques for nonpenaeid prawns. A number of industrial products such as chitosan, peptone, etc. have been developed in the laboratory from shell wastes. These products should be prepared on an industrial basis.

8.3.9 Separate financing arrangements and incentives should be provided for import and indigenous manufacture of trawlers. Material and machinery required for processing and packaging of prawns should be made available to the industry on priority basis to withstand competition. Systematic exploratory work for resources survey and assessment of deep water prawns should be conducted urgently so that this resource is fully and rationally exploited.

Lobsters

8.3.10 India has a lobster fishery of considerable magnitude, mainly of spiny lobsters belonging to the genus *Panilurus*. There is scope for increased exploitation of this fishery in some regions, whereas in conventionally exploited regions, there are signs of overexploitation. Investigations should, therefore, be conducted by the CMFRI, in coordination with the CIFT, for locating lobster grounds and finding out suitable types of gear and selective baits for expanding fishing effort for lobsters, with a view to increasing their production for export. Immediate action should also be taken by the State fisheries organisations to control the exploitation of lobster fishery, wherever signs of over exploitation are already evident, particularly on the southwest

coast of India. In view of the high price and demand for lobster in the world market, it is essential that sub-water lobster fishery exploitation is put on a systematic footing. The CMFRI and the re-structured deep sea organisation should, therefore, undertake a detailed exploratory work on the resources of deep sea spiny lobsters.

Crabs

8.3.11 Crab fishery consists of two marine edible species viz., *Portunus sanquinolentus* (Herbst) and *Portunus pelegrinus* (Linn) and one estuarine species, *Scylla Serrata* (Forskal). There are prospects for further development of the export trade in canned crab meat. While there are no definite estimates, large quantities of estuarine crabs are fished and marketed. Since the crab fishery is only an incidental catch of trawler operations, no special effort is made for their capture. Study of these resources and their further development is called for. Similarly, there is vast scope for the development of estuarine crab fishery because *Scylla Serrata* (Forskal) is a cultivable species. Steps should, therefore, be taken by the CMFRI and CIFRI to culture them on a commercial scale. This should be preceded by a pilot project in selected areas. Based on the catch data obtained from different coastal regions and the brackish water region, a potential resource of 44,000 tonnes per year is estimated implying a five-fold increase over the existing catches.

Squilla

8.3.12 The quantity of Squilla landed or which can be landed in the course of the present range of fishing operations is so high that it is difficult to ignore it in a developing system. These crustaceans, though observed in large quantities are seldom utilised or recorded. If proper reduction facilities are made available for Squilla catches, this fishery could provide a good source of high quality protein and a raw material for the industrial product, chitosan. The CMFRI and CIFR should undertake a study for resource assessment, and utilisation of this fishery, since they constitute an appreciable quantity of the trawl catches, which is now discarded.

Utilisation

8.3.13 Processing of prawns for export is at present based entirely on large sized prawns, which are mainly exported to the USA and Japan. Undue dependence of the sea food industry on export of

prawns to a few countries is not desirable. There is an urgent need for diversification in the export of marine products by finding markets for items like sardines, mackerels, nonpenaeid prawns, etc. in other countries as well. This would involve the spread of fishing efforts for prawns and other exportable varieties to as many centres in the country as possible by providing infrastructural facilities and quick means of transport.

8.3.14 The processing facilities, which are at present concentrated at a few places, should also be decentralised. Steps should also be taken for bringing about improvement in the processing as also handling facilities to ensure better quality of the products. Exports should be in small consumer packs to avoid thawing, refreezing and repacking in the importing countries and should be marketed under Indian labels. High standards should be kept up by strict quality and inspection control. The data regarding commercial aspects, such as the cost of operation of specific types of boats in different regions, should be collected to help the financing institutions in evaluating project reports.

Research

8.3.15 There are a number of problems relating to crustaceans, such as, survival rate, mortality, pattern of recruitment, migratory pattern and behaviour, physiological conditions, etc. which require detailed studies. Prawns complete their life-history in two environments, the sea and the estuaries, each having divergent characteristics. The ICAR should, therefore, establish field and laboratory facilities with particular emphasis on endocrinology, ecology, physiology and fishery biology and intensify research work on the migratory movements of prawns of commercial importance.

8.3.16 In the context of introduction of large scale prawn culture, studies on feeding habits of culturable species call for special attention. Developing artificial feeds for prawns is an urgent need. For this purpose, studies on food and feeding habits of different species should be given a high priority.

8.3.17 A survey of the seedprawn resources on both coasts of the country should be carried out. Seedprawn hatcheries may be established and experiments carried out on important commercial species to induce their growth and breeding in captivity. Ecological studies should be undertaken in greater details to obtain prefarming information within a short time.

8.3.18 Biologically, the crustaceans are widely different from true fishes and require special research and study. A separate research

division for the crustacean group should, therefore, be constituted in the ICAR which may develop, in course of time, into a separate Crustacean Research Institute.

General Suggestions

8.3.19 In the best interest of exploitation, management, research and technology and utilisation of crustacean resources and trade, the Government should set up a high level machinery to bring all these activities under a unified top level direction so that decision making is not fragmented in different Ministries/Departments. The fishermen, who are primary producers of prawns should be given financial support by way of loans and grants for purchasing mechanised boats and fishing gear so that they may increase their production and productivity. They should also be assisted to form cooperative marketing organisations.

8.3.20 In the export trade of prawns and other marine products, there is room for both the small entrepreneurs and the larger business houses. The larger business houses can bring much organisational skill and marketing competence to the industry. They can also make investments in large trawlers and upto date processing plants and can probably, achieve a higher standard in processed products. They should, however, be allowed to enter the industry only if they obtain at least upto 50 per cent of the raw material for their processing plants from their own fishing operations.

4 MARKETING OF FISH AND FISHERY PRODUCTS

Fish Marketing within India

8.4.1 Marketing of different varieties of fishes and shell fishes is a matter of great complexity. Demand for fish is at present limited to a few popular and prime varieties. Mackerel, oil sardine and other pelagic fishes, are caught in large quantities and are comparatively cheaper in price. Their increased marketing in inland areas, which have potential for absorbing enhanced supplies of marine fish would, therefore, constitute an important step in the development of marketing of marine fishes.

8.4.2 The lesser known fishes, which are nutritionally as important as prime fishes, should be popularised among larger sections of the consuming public through extension service and mass media. The Central and State fisheries organisations should take necessary steps

for educating the consuming public so as to make them conscious that icing of fish and gutting and decapitating of fish in filleting sector of the industry are necessary steps for maintaining the freshness and nutritive value of fish. Preparation of wholesome fish fillet on industrial scale should be encouraged. This would bring better returns to fishermen, which is important for economic viability of offshore fishing.

8.4.3 The landings are offered for sale not by weight but by measures of heaps, lots or baskets, which also vary depending upon the catch. State fisheries organisations should examine the question of introducing standard measures for different types and sizes of marine fishes at the primary marketing stage, which would facilitate proper marketing of fishes and also enable the collection of necessary data for marketing intelligence and evaluation of production economics.

8.4.4 Marketing sheds do not exist at a large number of landing sites along the coast. Proposed harbours cannot cover all the dispersed landing sites. Hygienic marketing sheds should, therefore, be provided at suitable fish landing centres. The construction of these sheds might have to be phased in the order of quantities of fish landed, so as to attract fish landings from adjoining centres. Another essential facility would be the provision of feeder roads, linking the fish landing sites which have considerable marketable surplus with nearest railway stations or motorable roads for onward transportation of the fishes by rail or by motor trucks for distribution.

8.4.5 Marketing of fishes from inland culture resources does not pose many problems. Problems would, however, arise in the case of capture fisheries of rivers, estuaries and reservoirs because of scattered landings at several places. It would, therefore, be necessary to identify the potential centres where such landings could be concentrated and marketing conditions improved by providing marketing sheds, preservation and transport facilities.

8.4.6 In many areas, particularly in the eastern sector, a long chain of middlemen exists in the fresh fish trade leading to increase in consumer price. The State fisheries organisations and marketing authorities should examine the question of eliminating unnecessary links in the prevalent trading practices by introducing a system of licensed functionaries in fish marketing to the best advantage of the producers and consumers. The fisheries cooperatives should also assume an increasing role in marketing functions by raising their standard of efficiency in marketing methods and making marketing an obligatory function in their bye-laws. The cooperatives will have to be provided with necessary credit for working capital from governmental resources and financial institutions.

8.4.7 The quality of fish that is marketed at present requires con-

siderable improvement. The responsibility to preserve the quality for primary marketing lies with the fishermen while that of maintaining the quality of fresh fish in ice up to the retail level, including packaging, transportation and sanitation in the retail markets is on the trade. Marine catch is processed into different forms, such as fresh fish, canned, frozen and cured products. It should be ensured that the material used for processing and curing industry comprises wholesome fish. Improvements in curing methods are also necessary. The national standard specifications for different fish and fishing products, brought out by the ISI on the basis of the draft specifications mainly developed by the CIFT, are being followed mainly for export products through preshipment inspection. Due to the lack of satisfactory surveillance in the system of quality control and inspection, the observance of these standards in respect of fish and fishery products for domestic consumption is voluntary. As the inspection of quality is administered through the public health services, improvement in the inspection of fish and fishery products could be brought about by imparting short-term training in quality control and inspection to the personnel of this service. Short-term training courses in quality control and inspection of fish and fishery products should, therefore, be organised at a suitable central fisheries institute. The requisite national standards for analytical methods in quality control and inspection should be formulated jointly by the ISI and Central and State fisheries organisations. In order to avoid wastage of ice and fish, the CIFT should intensify research on proper procedures for chilling different types of fishes and finding out suitable type of containers for packaging and formulate specifications on the methods of packing fish and ice. The CIFT should also undertake pilot projects, in coordination with the State fisheries organisations, to demonstrate the economic advantages of mechanical air-dryers over the existing traditional methods, in some of the suitable area, where sun-drying of fish is being predominantly undertaken.

8.4.8 The Central Fisheries Corporation, in coordination with the State fisheries corporations, should establish freezing plants and storages near important production centres wherefrom bulk quantities of fish could be obtained at comparatively cheaper price. This would not only relieve gluts at production centres, thereby giving an economic advantage to the producers, but would also increase supplies of fish in seasons of shortage at reasonable price to consumers even at distant places. The Corporation should also set up such freezing plants and storages at important consumption centres, particularly in those areas where fish constitutes an important item of food.

8.4.9 The State fisheries organisations should promote introduc-

tion of motor trucks for carrying iced and frozen fish over short distances by giving necessary financial assistance to fisheries cooperatives. For improving the transport system for carriage of iced and frozen fish over long distances, the question of introducing insulated rail and road vans on large-scale should be examined as an intermediate stage in the development of refrigerated transport system.

Export of Marine Products

8.4.10 India's share in the international export trade of marine products is negligible. There is considerable scope to expand the export trade of Indian fish and fishery products by undertaking necessary promotional measures by Marine Products Export Development Authority (MPEDA). Under section 9 (2) (a) of Act 13 of 1972, developing and regulating offshore and deep sea fishing, and undertaking measures for the conservation and management of offshore and sea fisheries, come within the scope of the Authority. These functions also fall within the purview of the Department of Agriculture and State fisheries organisations which have the necessary technical expertise and facilities. The anomaly created by the assumption of these functions by the Authority should be removed by the Government, so that the Authority directs its concerted efforts towards the promotion of export of marine products.

8.4.11 The utilisation of installed freezing capacity is only 30 per cent. It would be advisable to increase the rate of utilisation as much as possible, both for export and for domestic consumption, as sardin, mackerel etc., are caught in sizable quantities in the areas where frozen capacity has been largely established. The MPEDA sardine, mackerel etc., are caught in sizable quantities in the areas capacity of freezing plants and storage for increasing export of marine products and domestic consumption of frozen products.

8.4.12 In addition to prawns and lobsters, there are possibilities of increasing the export of froglegs by popularising this product in affluent countries for which the MPEDA will have to take necessary promotional steps. For increasing domestic production from capture operations, the CIFRI should prepare detailed methodology and set guidelines for undertaking population surveys of commercial species of frogs by State fisheries organisations. As regards culture of frogs, experimental studies conducted by CIFRI have given some encouraging results. The ICAR should, therefore, undertake a pilot project for establishing the economic feasibility of frog culture with a view to adopting field practices in utilising some areas of freshwater swamps for frog culture.

8.4.13 For intensifying promotional programmes for the export of canned products by the MPEDA the fish canning industry should be supported by the supply of empty cans manufactured from imported tin plate at subsidised rates to enable it to compete in the international markets. The MPEDA should make efforts to diversify the export of cured and dried products to other countries.

8.4.14 To improve the quality of export products and bring them to international standards, the MPEDA should set up guidelines and procedures for necessary improvements in the processing sector of the fishing industry oriented for export purposes. Further, the State Governments should give priority consideration to the adequate supply of portable water and the uninterrupted electricity supply to fish processing industry. It will be necessary for the Central Government to ensure that the export consignments are given expeditious clearance.

Industrial Fishery Products

8.4.15 The production of fishmeal needs to be increased in order to meet the growing demand for preparation of livestock and poultry feed for which demand is high in the international export trade. To increase its production, and incidentally of fish oil as a byproduct, it will be necessary to introduce a few small scale factory ships, with small modernised fish meal plants on board, which could exploit the extended pelagic fishery resources in addition to installation of pocket size fish meal plants on larger trawlers to utilise trash fish caught by them.

8.4.16 Masmin produced commercially from tuna landings in Lakshadweep islands is of low quality and has a poor shelf-life. There is scope for improving its texture and storage life by adding preservatives and developing proper packing methods.

8.4.17 Apart from fish meal, fish body oils and masmin, a number of other industrial fishery products, such as, crab concentrate, frozen dressed turtle meat, fish paste and fish sausages, shark liver oil and shark skin leather, fish glue and pearly essences etc. can be prepared on small scale industry basis, for which markets have to be developed. Although considerable spadework has been done by the CIFT on the possibilities of preparing various industrial fishery products, there is yet no established industry for utilising the new materials. The CIFT should prepare technoeconomic feasibility reports for manufacturing various minor fishery industrial products on small scale industry basis.

9

FORESTRY

9.0.0 Forests produce the requisite raw materials for industries, defence, communications, other public purposes and domestic use, contribute to the country's export, and create a large volume of employment in the primary, secondary and tertiary sectors. They also provide materials like fuelwood, small timber, fodder, grazing etc. for direct use by the agriculturists. The benefits from forests in the matter of soil and water conservation, recreation, wildlife, etc., have been well recognised. This chapter deals with the entire range of activities connected with the development of forestry as a factor in agricultural progress, as a source of raw material for industrial and other uses and export, as a means of sustaining ecological balance and as a provider of employment to large sections of tribal and other population living in or near the forests.

9.0.1 In the thirties and forties, the stress in forestry was more on attaining 'normal forests', the works of improvement being guided by the revenue potential in a region and not always by considerations of overall development of the country's forests. The main reasons for this approach were limited market demand for secondary species and inadequacy of funds for creating large scale man-made forests. The revenue did not suffice for a programme of regeneration and maintenance. Against this background, the Forest Departments followed the practice of selection felling and improvement even in good areas of growth, resulting in low levels of production, income and employment.

9.0.2 The focus in the planned era has, however, been on a more economic and efficient utilisation of the valuable forest products. Programmes have been initiated for creating large scale plantations of valuable species and those of economic and industrial importance, several wildlife sanctuaries have also been set up.

1 FOREST POLICY

9.1.1 In 1952, the National Forest Policy of 1894 was revised to give a direction to the development of forests. A Central Board of

Forestry was constituted earlier in 1950 at the ministerial level for forging an all India approach in the forest policy pursued by the various States. The provisions of this policy have not, however, been fully implemented by the States for various reasons. Examples are non-implementation of the functional classification of forests provided for in the policy statement, lack of any systematic programme to extend the existing treelands and establish new ones and relinquishment of forest lands for various purposes. Also no concerted efforts were made to bring the recommended 60 per cent of area under forests in the mountainous tracts liable to erosion and 20 per cent in the plains. Hardly any of the principles on forest grazing were implemented. If the policy had been adopted by the State Legislatures its implementation would have been more effective.

9.1.2 Since the enunciation of the policy in 1952, developments of far-reaching importance have taken place in the economic, social and political fields. Increase in population has given rise to diversified demands for a great variety of products on the one hand, and built up heavy pressure on land on the other, resulting in a substantial loss of forest lands. As self-reliance is the fundamental objective of future economic and industrial development, there is need for the concept of multiple use of forest lands and far greater attention to increase the productivity of forests and their scientific management on modern lines.

9.1.3 The national forest policy should rest on two pivotal points, viz., to meet the requirements of goods, i.e. industrial wood for forest based industries, defence, communications and other public purposes, and small timber, fuelwood and fodder for the rural community and to satisfy the present and future demands for protective and recreative functions of the forests. All the requirements must be met in full and self-sufficiency achieved as early as possible. The policy should indicate clearly the inter-relationship of forest economy with rural and tribal economy. The factors to be considered are : (a) employment; (b) rights of user; and (c) involvement of the local people. Employment could be offered as an alternative to rights of user, if forest development is properly organised.

9.1.4 Forests must have an adequate share of land and disforestation should not be permitted without the approval of the State Legislature. Any inevitable diversion should be made good by bringing some other areas under forests. All forests, under management of other departments of the Government, should be transferred forthwith to the Forest Departments. Regulation and control of private forests are also imperative. Bearing in mind the future demand on the forests, all forest lands should be functionally classified into : (a) pro-

tection forests; (b) production forests; and (c) social forests.

9.1.5 Protective influence of the forests, specially on hill slopes, watershed of rivers, river banks, sea shores and other localities vulnerable to erosion and degradation, should be developed in full by suitably managing the existing forests and providing for their rehabilitation and improvement. The basic policy for management of production forests must be to meet the needs of the existing and projected industry and for well-established uses. Growing of plantation crops like rubber, coffee, cashew, etc. in suitable localities on forest lands should be undertaken, consistent with the objectives of forest management. Underplanting of such crops as turmeric, ginger, cardamom, etc. should be encouraged, where possible. In keeping with the production forestry programme, adequate investment of capital should be ensured in forest based industries, which should be located, to the extent possible, near the source of raw material. Development of communications should be particularly ensured in inaccessible areas, and superior exploitation techniques adopted to utilise the forest potential to the maximum extent possible. The social functions of forests would be to meet the following needs of the community insofar as they are consistent with other objectives : (a) agricultural timber and fuelwood; (b) grazing and grass; and (c) recreation. One of the principal objectives of social forestry should be to make it possible to meet these needs in full from readily accessible areas inside and outside the regularly constituted forests, and thereby lighten the burden on production forestry.

9.1.6 Provision of employment of local people through forestry practices should be recognised as an important element and steps should be taken to see that the increasing rural employment created through production and social forestry goes mainly to the socially backward like tribals and unemployed and underemployed agricultural labour.

9.1.7 The National Forest Policy should be revised to take into account the above, and also other related needs like controlled grazing, regulation of shifting cultivation, welfare of tribals, protection of wildlife and plants, forests research and education, extension and publicity, legislation on forestry and strengthening of forest administration at all levels. After approval of the draft by the Central Board of Forestry, it should be legislated by the States.

2 PRODUCTION AND SOCIAL FORESTRY

Demand and Supply Projections

9.2.1 Demand and supply projections up to 2000 AD have been made for industrial wood and fuelwood in terms of primary forest

products. The requirement of sawnwood, panel products and round wood has been calculated on the basis of income elasticity of demand and on the assumption that after 1985 relative consumption of sawn and round wood is most likely to go down as more panel products come to the market and changes in construction design of houses are brought about. However, since there are no reliable past data on consumption, studies should be undertaken on consumption trend of sawn and round wood for the next ten years and the targets revised on the basis of more realistic data.

9.2.2 As regards pulp and paper, a direct relationship between the growth in their domestic consumption and the growth in gross domestic product (GDP) has been assumed and alternative regression functions fitted to the estimates of per capita GDP and per capita consumption of various categories of paper and pulp during 1950 to 1970. It has been further assumed that the recent trend would not undergo any significant change at least during the next decade, and in a longer term perspective extending to the turn of the century it is possible to rectify the past imbalances in the consumption of various categories of pulp and paper by proper planning of forestry and forest industrial sectors. High and low estimates of demand for industrial wood have been made for 1980, 1985 and 2000 AD under assumption of different rates of income growth as explained in chapter 3. The estimates are given in Table 9.1.

TABLE 9.1
Aggregate Raw Material Requirement under Assumptions of
High and Low Income Growth

(in '000m 3(r).

Item	1980		1985		2000		AD
	high	low	high	low	high	low	
coniferous wood	4,740	4,385	6,240	5,265	13,130	9,055	
hardwood	22,155	20,620	28,940	24,765	51,320	38,125	
Total	26,895	25,005	35,180	30,030	64,450	47,180	

9.2.3 On the basis of Fuel Policy Committee Report (1974), the consumption of fuelwood in 1970-71 has been derived as 277 m³ per 1000 caput and the total consumption as 150 million m³. No significant diversion from noncommercial to commercial fuel is visualised so as to have any appreciable effect of the present pattern of fuel consumption. However, a deliberate policy should be adopted to reduce

the consumption of cowdung, and its percentage in the noncommercial fuel must be brought down from the present 15 to 5. After considering all factors involved, fuelwood requirement has been projected on the basis of 1970-71 per capita consumption remaining the same upto 1985. It has been assumed that after 1985 per capita consumption may marginally go down every year, and in 2000 AD it could be 240 m³ per 1,000 caput. The total requirement of fuelwood expressed in million M³ would be as follows :

1970	.	.	.	.	.	150
1975	.	.	.	.	.	165
1980	.	.	.	.	.	184
1985	.	.	.	.	.	202
2000	.	.	.	.	.	225

9.2.4 The requirement of industrial wood in 1970 was about 15.9 million m³(r), of which about 2.7 was of softwood and 13.2 of hardwood. The estimate of recorded production of industrial wood was only 8.92 million m³(r), comprising the hardwood production of 7.63 million m³(r) and softwood production of 1.29 million m³(r). In the matter of fuelwood, the recorded production was only 13 million m³. In addition to the requirement of industrial wood for domestic consumption as shown in Table 9.1, it would be necessary to make arrangements for supply of additional wood for entering the export market more vigorously from 1985 onwards in respect of sawnwood and plywood and veneer. The additional requirement would be 3.0 to 3.7 million m³(r) in 1985 and 4.8 to 6.6 million m³(r) in 2000 AD, corresponding to the two rates of income growth. The demand of industrial wood and fuel wood will be met by :

- (i) man-made forestry programmes;
- (ii) concentrated natural regeneration programmes;
- (iii) working of inaccessible coniferous and hardwood forests by infrastructural development;
- (iv) thinnings and final fellings of existing plantations; and
- (v) social forestry.

Till the turn of the century, a large part of the industrial wood supply would come from the existing forests, where efforts for greater production should be initiated through natural or artificial regeneration, according to the biological characteristics of the main species involved. Considering the limited availability of coniferous forests, an annual area of about 20,000 ha should be brought under tropical pine plantations by 1980 at the latest.

9.2.5. An extent of about 48 million ha, including 2.7 million ha of coniferous forests, should be identified immediately for being dedicated as production forests in use. Keeping in view the magnitude of

administrative and technical efforts needed, and the average rotation for conversion of forests to even-aged ones, the regeneration operation in 2000 AD can be visualised as follows :

Table 9.2
Regeneration Operations—2000 AD

Annual area (ha)	Average rotation (yrs)	Purpose	Total required (million ha)
man-made forestry :			
20,000	35	coniferous pulpwood (tropical pines)	0.7
160,000	15	hardwood pulpwood	2.4
200,000	60	saw logs, veneer logs etc.	12.0
natural regeneration :			
30,000	90	coniferous wood	2.7
400,000	75	hardwood	30.0
Total :			47.8

9.2.6 Considering the present working of the forests in different States and the annual wood removal per ha from such forests, it should not technically be a difficult task to obtain industrial wood removal of the magnitude required, since it has been possible to reach a very high mean annual increment in the plantation crops.

9.2.7 It may not be possible to obtain more than 60-70 million m³ of fuelwood as byproducts of production forestry in the form of lops and tops and residues of forest based industries. In the rural economy woody and shrubby growths on uncultivable wastelands, fallows or in the villages or on the bunds of agricultural fields would continue to be used as fuel. The balance requirement of fuelwood in the rural areas must be met through a dynamic programme of social forestry. Dependable statistics of the fuel wood production through the programme of social forestry should be collected. The transport of fuelwood to urban areas should be discouraged in the long run and the entire requirement of the urban areas met from commercial fuels.

The Interim Report on Production Forestry

9.2.8 In the Interim Report on Production Forestry—Man-made Forests (August, 1972), it has been recommended that the future production programme should concentrate on clearfelling and man-made forestry, priority being given to the opening up of inaccessible forests followed by mixed quality forests and valuable forests. It has further been emphasised that production forestry is a business and should have a close link with marketing and utilisation. Adequate capacity in the forest based industry should be planned in such a way that the utilisa-

tion of the products from man-made forestry programme is synchronised with the setting up of a specific industry.

9.2.9 The agency to implement the man-made forestry programme and the supporting forest industries in the States should be organised in the public sector as a fully owned State company or a corporation. Each State might have one or more corporations according to the size of the programme and the location of the forests under the programme. Such of the corporations that take up supporting paper and pulp industry could either set up the industry as a subsidiary of the corporation or form separate companies.

9.2.10 The areas selected and considered fit for commercial production should be transferred by the State Governments to these corporations. The values of such forest lands and the standing timber thereon would form the basis of the equity capital against which they could borrow from institutions. Where these values are inadequate to generate sufficient funds in time for the industrialisation programme, the State Governments may have to subscribe additional equity funds to the corporations from their plan resources. If the statute of the Agricultural Refinance and Development Corporation cannot be amended to allow direct long term finance to the forest development corporations, a Central Forest Credit Corporation should be organised to take up the responsibility for providing long term finance for plantation and development programme. For the industrial programme based on forest raw material, there are institutions for industrial lending.

9.2.11 The massive programme of man-made forests will require careful selection of the species to be raised, the mixture to be followed and the estimation of production. The decision on rotation should be taken on the basis of economic criteria, but the programme would permit considerable shortening of rotation.

9.2.12 The price of the produce should be so fixed as to pay for the cost of clearfelling and plantations and leave a profit. For the pulpwood, a low priced material, the paper industry should be in a position to pay higher royalty if uniformity of raw material is assured through plantations created within a reasonable distance from the factory.

9.2.13 Forest lands should not be leased to the forest based industries for raising plantations. These lands are utilised for multiple purposes; moreover, the policy of the Government is to take over all forest lands in the country under State management. The products, however, should be allocated to different industries at an economic price in order that a commercial high investment and economic forestry can be introduced.

Export Potential of Indian Timbers and Processed Products

9.2.14 Demands for timber and processed wood products appear to be mounting and are going ahead of indigenous supply in developed countries. But the exports from India have been limited so far to a few traditional items in restricted quantity. These items have a high value even in the domestic market. The main drawbacks in organising a proper export drive have been the nonavailability of data of the type required to organise export, consistent market intelligence studies and active organisation to coordinate the efforts. An analysis of the species exported shows that dependence has been almost solely on rosewood, followed by sandalwood and red sanders. Other species exported in small quantities are *sal* (*Shorea robusta* Gaertn. f.), teak (*Tectona grandis* Linn. f.) and some from the tropical evergreen forests, such as dipterocarps, *Terminalia*, *padauk* (*Pterocarpus delbergioides* Roxb.), etc.

9.2.15 The traditional market for round timber should be converted into markets for sawn timber. Japan and Western Europe offer promise in this respect. It is found that most of the species, which constitute about 90 per cent of timber import into Western Europe, are moderately durable to very durable. A few common Indian hardwoods, as identified should, therefore, be taken up for vigorous export promotion. The trade names of these species should be standardised for export purposes and the Forest Research Institute, Dehra Dun (FRI) should take up preparation of publicity material pointing out the characteristics and uses of each species and its equivalence to those already in demand in the export market.

9.2.16 The prospects of diversion of home grown sawnwood for export should be studied in depth. Imposition of heavy excise duty on teak sawnwood should be considered, so as to restrict domestic consumption. With a view to earning foreign exchange, export of species that are in demand in the market should be allowed liberally, and the use of other available hardwoods as substitutes developed in the domestic market. Areas of abundant availability of timber should be located for establishing saw mills and other industries for export purposes. In the saw mills, established primarily with an eye to export, precision machinery should be installed and kiln-drying facilities introduced. There should also be adherence to grading. Glue of international quality should be made available at international prices to plywood factories specifically oriented towards export.

9.2.17 The price of wood and wood products offered are fairly attractive and India has timber and timber products for export in acceptable quality and quantity in specific regions. As promotion of

export would require a well concerted effort, there should be an Export Promotion Council for Forest Products. For guaranteeing supply and ensuring quality, the forest development corporations would have to play a substantial role. These corporations should undertake promotion of exports and allocate finance needed for export promotion activities. A suitable training programme for the personnel to be incharge of export oriented forest industry should be devised in consultation with the Indian Institute of Foreign Trade.

Expanding Industrial Use of Forest Products

9.2.18 No planning of forest development is possible outside the ambit of planning for forest industry. The effect of technology changes, already introduced or which may be introduced in future, on the use of forest products is important from the point of view of forest development. The change effected in raw material production in forest as a result of new technology is illustrated by the use of bamboo as a pulping material. Natural bamboo forests cannot be worked for production of bamboo as pulp material only, because it will lead to low productivity. The cost of artificial regeneration of bamboo is high and hence the remunerative price is often beyond the capacity of pulp industry to pay, though as a construction material bamboo from plantations can fetch an economic price. Silviculturally, concentrated bamboo plantations have not been much of a success. Moreover, recent experiments with tropical pines have shown that they can be grown in similar areas and give a much higher outturn as compared to bamboo plantations. The manufacture of fibreboard from mixed tropical hardwoods, currently technically feasible, may soon become economic, resulting in more complete utilisation of wood fibre. It will be necessary to undertake research and develop technology and equipment for utilisation of noncommercial hardwoods in the panel industry and particularly for a simultaneous use of a variety of wood species to ensure greater utilisation of the mixed tropical forests. Since particle boards and fibreboards make greater use of secondary raw material and residues from logging, saw mills and other industries, the poor record of production of these two industries should be looked into to improve their performance.

9.2.19 The growing demand of wood for the match industry should be met both by conserving the existing resources and by raising new plantations. In addition, poplar (a good matchwood) should be raised, where feasible, in pure plantations in forest areas and encouraged for planting under the programme of farm forestry. All matchwood species should be reserved for the exclusive use of match industry.

While deciding the funds for an aggressive programme of raising matchwood plantations, the State Governments should not only take the price of raw material into consideration but also other financial benefits, such as excise duty and sales tax, that would accrue to the Government on production and sale of matches. In view of the shortage of matchwood in the mainland, expansion of large scale matchwood industry, particularly in making splints and veneers may be confined in future to the Andaman & Nicobar Islands.

Logging and Mechanisation

9.2.20 To meet the urgent need for improving the logging techniques in the country, the Government of India set up a Logging Branch in the FRI in 1957 for conducting research in the logging problems of the Forest Departments. For training in use of modern tools for wood harvesting including felling and transport, a Logging Training Centres Project was established by the Central Government in September, 1965 in collaboration with the United Nations Special Fund (UNSF). It is at present running four training centres in various parts of the country.

9.2.21 In the light of the experiences recently gained in some States, a selective mechanisation in logging should be adopted thereby removing impediments in the opening up of inaccessible forest areas and effecting a reduction in logging and transport cost. Generally, the emphasis should be on mechanical innovations of lower technical sophistication such as skyline cranes, ropeways, mountain tractors and improved logging tools. For loading and unloading, mechanisation should be adopted only where the quantity of timber to be handled annually is large. With partial mechanisation as suggested, it may be possible in the plains to effect mechanical site clearance so that supplementary agricultural activity (e.g. *taungya* method) can be intensified requiring more labour. With increased production it will also be possible to offer sustained employment at reasonable minimum wages to the persons engaged in logging.

9.2.22 There should not be any mechanisation either in nursery operations or in planting, except in pockets of very high wages and dearth of skilled labour. Regarding the plains forests, it may be advantageous in many places to uproot the trees by dozers followed by site clearance and then tractor cultivation to permit growing of arable crops presently in short supply along with planting of forest species. Beyond this, no mechanisation is called for.

9.2.23 One of the reasons for slow adoption of mechanisation and use of basic logging tools has been the nonavailability of suitable indi-

genous machines and tools. The Logging Training Centres Project and the Logging Branch of the FRI should arrange that selective mechanisation and use of improved basic logging tools be put into operation. An adequate organisation should be set up for departmental logging, either through direct employment of local labour or through labour cooperatives. As far as possible no sale of timber standing in the forests should be made. After departmental logging, timber should be brought to sale depot outside the forests.

Infrastructure and Inputs

9.2.24 Roads are by far the most important infrastructure to be provided for production forestry. Roads passing through the forests are mostly constructed and maintained by the Forest Departments but there are often a few arterial roads maintained by the Public Works Departments. The average density of forest roads in the States is about 0.20km/sq km. The requirement by 2000 AD for the production forestry area has been projected at 0.75 km/per sq km. Considering the present road density and the existing and future roads constructed or to be constructed, under the auspices of other organisations, it should be necessary to plan for the construction of about 215,000 km of additional forest roads in the next 25 years for successful implementation of the production forestry programmes.

9.2.25 In the production forestry the use of chemical fertilisers for obtaining higher growth rate would be one of the standard techniques. Each State should create facilities for soil testing by setting up small soil laboratories under their research organisations so that the most economic doses of fertiliser are adopted. A review of the fertiliser requirement, current as well prospective, should be undertaken.

9.2.26 Quality seeds are essential for the success of production forestry. The seed testing rules and seed certification scheme framed by the FRI should be adopted by the State Forest Departments. The State forest research organisations should formulate, in consultation with the FRI, proper guidelines for pretreatment of forest seeds, seed storage, selection of *plus* trees of important species, and establish seed orchards and clone multiplication plots where necessary. In the case of imported seeds a list of quarantine procedures and regulations affecting trees, seeds, seedlings and wood products should be compiled. Greater reliance should be placed on pre-entry quarantine inspection in the country of origin and regular post-entry quarantine inspections of all nurseries and plantations raised on imported seeds.

9.2.27 Irrigation is resorted to in raising canalside plantations in the arid areas of Punjab, Haryana, Gujarat, Uttar Pradesh, etc. Irri-

gated plantations have also been raised along the roads and in blocks. Normally raising irrigated plantations in small scattered patches will not only create difficulties in their management but also serve little purpose. The Forest Departments should, therefore, identify the wastelands and marginal lands within the canal command and where a minimum of 100 ha at one place is available for raising irrigated plantations, prepare estimates of funds and water requirements for inclusion in the reports of the irrigation projects. At present there is very little information on the water consumption of different species. The Council of Forest Research and Education (CFRE), as recommended to be set up in the Interim Report on Forest Research and Education, should initiate studies on this aspect in order to minimise the extent of irrigation as well as to avoid overirrigation.

9.2.28 Institutional credit for production forestry programme is essential for the forest development corporations. However, there has as yet been no Central assessment of the quantum of institutional credit that might be required in the forestry sector in the coming years for production, export and industrial programmes as envisaged. The forest planning cell in the Union Ministry of Agriculture and Irrigation should take up the study of the quantum required by the forest development corporations, at least up to the year 1985. Amendment of the tax laws should be considered, so that reasonable deductions from the net income from the sale of the existing crop are allowed to the forest development corporations, for creation and maintenance of man-made forests on the felled areas.

Control of Forest Diseases and Insects

9.2.29 Forest diseases and insects take a considerable toll of the productivity, usefulness and value derived from the forest resources, and cause damage to standing trees as well as wood in storage. Majority of forest diseases and insects in respect of important economic forest tree species have been identified and recorded. In view of greater emphasis now on the utilisation of secondary species, the programme of identification of forest diseases and insects should be enlarged and check lists prepared giving their geographical distribution as well. In view of the great demand for economically important timber, secondary species and less valuable timber should be used for domestic requirements after seasoning and preservative treatment. The Government departments should give more importance to the use of such timbers. The economically important and very often naturally durable timber may be kept for the purpose of export so as to earn more foreign exchange.

9.2.30 Before deciding upon any control measures, the impact of the disease and insect attack should be evaluated, if possible by techniques of cost-benefit analysis, and the feasibility and the magnitude of control measures worked out. The control measures would mainly be biological and silvicultural, chemical, integrated management and quarantine. Genetic control should also be resorted to by breeding strains immune or less prone to noninjurious organisms. Chemical control should be used after careful consideration of the effect of chemicals on nontarget organisms which may include predators or parasites of the target organisms and many others useful to man.

9.2.31 An increased danger from diseases and insect pests in man-made forests has been noticed in many places, particularly because of the introduction of exotics. While taking up the man-made forests programme, the eventualities of increased danger from these sources should be considered and protective measures provided for before undertaking the programme.

Social Forestry

9.2.32 The bulk of the rural population of the country has been getting their requirements of fuelwood and small timber for agricultural implements and rural housing partly from farm and community lands and partly from the protected and reserved forests. Due to a rising demand and inadequate steps taken to augment the resources, much of the tree growth of farm land has already been cut down without replacement and community lands in most cases are bereft of their vegetal cover.

9.2.33 In the past, farm forestry was adopted as a means of creating new wood resources and replacement of wood harvest in farm lands, community lands, etc. Plantations have also been raised in some States on lands along the sides of roads, canal banks and railway lines. But the progress of these activities has not been uniform; nor was the programme related to the needs of the community. Though the objectives of *vanamahotsav* are basically sound, the programme has not generated the enthusiasm and tree consciousness expected of it. The Interim Report on Social Forestry was submitted in August, 1973 in this context.

9.2.34 Social forestry should aim at meeting the needs of the community and have the following objectives :

- (i) fuelwood supply to the rural areas and replacement of cowdung;
- (ii) small timber supply;
- .(iii) fodder supply;

- (iv) protection of agricultural fields against wind; and
- (v) recreational needs.

Accordingly, the scope of the social forestry programme would include farm forestry, extension forestry, reforestation in degraded forests and recreation forestry. Social forestry, particularly farm forestry and extension forestry, can be the only practical steps for increasing the area under forests and tree growth.

9.2.35 The basic component of farm forestry would be to motivate the farmers and to organise a substantial programme of planting of trees in the bunds and boundaries of their fields. The State Forest Departments should plan for extensive nurseries and create the necessary organisation to assist and guide the farmers and demonstrate to them that an economic return from the practice is possible without its having any adverse effect on crop yields.

9.2.36 Recently, the value of trees was brought under the purview of the Wealth Tax Act. In the context of present day energy crisis and fuel shortage and the pressure on the overburdened transport system for carrying coal from distant places, farmers should be provided incentives to take to planting of trees on their farms on a large scale. In the Union Budget for 1975-76, provision has been made in the Wealth Tax Act exempting the value of trees standing on agricultural land (not being trees in any orchards or plantations) from wealth tax. This should form a permanent provision in the Act.

9.2.37 Extension forestry is to cover : (a) mixed forestry on wastelands, *panchayat* lands and village commons; (b) raising of shelter-belts in dry and arid regions; and (c) raising of plantations of different quick growing species on lands on the side of roads, canal banks and railway lines. Some of the recommendations made in the Interim Report on Social Forestry are highlighted below.

9.2.38 The programme should be of mixed plantations, be such as is acceptable to the villagers and should provide for raising a quick yield of fodder and grass, in addition to fuel, as these are the villagers' immediate concern. Income from mixed forestry should be divided equally between the *panchayats* and the State Governments. In addition, in the disposal of the produce from these forests there should be an element of preferential treatment including price preference to the villagers.

9.2.39 Where sufficient extent of degraded forests exists within a reasonable distance of rural and semi-urban complex, reforestation programme could be taken up linking such forests with the complex for supply of fuelwood and small timber without substantially upsetting the rights of user in the villages in the area. The Forest Departments should encourage the practice of agrisilviculture (*taungya*) in reforesta-

tion sites, wherever favourable conditions exist, to provide employment and simultaneously increase production of grasses, fodder and arable crops. Each State Government should make a study of the problem of recreational needs of the urban areas and dedicate some forests or establish tree groves near such areas for recreational purposes. Green belts around towns and cities where necessary should also be created.

9.2.40 Suitable forestry extension organisations should be created at the Centre as well as in the States and entrusted with the responsibility for implementation of the programmes of social forestry. Training in extension methodology and technology should be imparted to selected officers, engaged or to be engaged for implementing the programme, at various agricultural universities and research institutions, where a department of extension exists, or by starting an extension branch at the FRI. The agricultural universities should include in their syllabi a course on social forestry for the agricultural graduates. The strategy for popularisation of social forestry should include the establishment of a large number of field demonstrations. The active participation of the three basic village institutions, viz. local *panchayats*, cooperatives and school staff, should be secured in these demonstrations. Priority should be accorded to the programmes of research in social forestry by creating special cells or by expanding the existing facilities at various research institutes concerned, viz. FRI, Central Arid Zone Research Institute, agricultural universities and similar research centres in the States.

Role of Forests in Soil and Water Conservation

9.2.41 The importance of the forests in modifying the hydrology of watersheds and in soil conservation has been well recognised. Suitable management of the existing forests and their rehabilitation in localities vulnerable to erosion and degradation would ultimately lead to the maintenance of water balance, control and erosion, prevention of rapid silting of reservoirs and moderation of floods. For the efficient and productive use of land, soil and crop management should be on a watershed basis.

9.2.42 Since forest lands occupy a large proportion of the river valley catchments and exercise material influence upon soil stabilisation and stream flow characteristics, the conditions, management and improvement of forest lands should, as a matter of rule, be the concern of the watershed management programme. Particular attention should be paid to the degraded forest lands which should be brought back to proper conditions through reforestation, wherever necessary. A number of biotic factors, such as grazing, fire, lopping, shifting cultivation,

litter removal, etc. are affecting the hydrological process under different forest conditions in the catchments. In order to get full benefit from forest management in catchment areas, therefore, measures suggested with respect to forest grazing, shifting cultivation and forest protection, should be vigorously pursued. The degraded lands in the catchments outside the forest areas should be brought under social forestry and linked with the programmes of livestock development.

9.2.43 Indiscriminate misuse of land by disturbing the prevailing ecology along the river banks has led to the formation of gullies and ravines. Ravine formations are estimated to have damaged 3.67 million ha in the States of Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Punjab, Bihar, Tamil Nadu and West Bengal. The multidisciplinary approach to ravine reclamation has been accepted in the most affected States, and is likely to be followed in future years. However, the ravines starting from their upper end to their confluence with the main river should be treated as a whole. In general, the heads of ravines should be treated for developing grasslands in association with animal husbandry programme, while middle to lower slopes and deep ravines should be tackled by afforestation, supplemented, if necessary, by soil conservation engineering. No grazing should be allowed in developed grasslands and the areas afforested.

9.2.44 An enormous sediment load is carried by hill torrents, called the *chos*, emanating from the Siwaliks. The Punjab Forest Department took the lead in initiating action on the control of *chos* and reclamation of the *chos* devastated land for better land use from the beginning of this century. It has developed the technique and gained considerable experience. Afforestation appears to be the best solution and the techniques already evolved by the Punjab Forest Department should be extensively adopted.

9.2.45 The recommendations for the control of sand dunes in the hot desert are given in the Interim Report on Desert Development. There are, however, large areas along the coastal line lying under comparatively smaller sand dunes especially in the coastal districts of Tamil Nadu, Maharashtra, Gujarat and Orissa. The area under coastal sand dunes is on the increase and the blown sand is causing serious damage to the standing crops in the neighbourhood. The Forest Departments have developed the necessary technology and gained experience in this regard. They should take up coastal plantations of *Casurina*, eucalyptus, coconut, etc. extensively for profitable land use and controlling erosion of the coastal tracts.

9.2.46 Whether it is for soil conservation through forestry or through an integral programme, trained personnel in the Forest Departments are essential. But the Departments do not take adequate advan-

tage of the training facilities available. The State Forest Departments should assess their requirements of training for higher professional staff, Forest Rangers, Deputy Rangers/Foresters, etc. and avail of the training facilities that are available, or that might be created in future, in different training centres.

Grazing in the Forests

9.2.47 Grazing in the forests would have to be allowed in view of the role of livestock in the country's economy. But instead of unlimited and continuous grazing, it should be controlled and restricted so that it does not interfere with the productive and protective functions of the forests. The resources of the forest areas should be utilised for the feeding of the essential livestock, and grazing by goats in all forests should be prohibited. Sheep grazing may be allowed only in specially earmarked grasslands in the forest areas under strict rotational control.

9.2.48 It is difficult to make a quantitative estimate of incidence of grazing in the forests without detailed sample studies as rights and privileges vary widely from State to State. From the available statistics it is found that, while the total livestock in India increased by 18 per cent, from 302 million in 1956 to 355 million in 1972, the total number of animal which grazed in the forests increased by about 52 per cent, from about 35 million to 54 million. The practice of limiting the number of cattle to the carrying capacity of the forests based on arbitrary assumptions has been in vogue in certain States. If as an average for the country, 1.6 ha per cow unit is assumed to constitute conservative grazing, it is found that safe margin of forest grazing has been far exceeded.

9.2.49 Concessions are generally in the form of low rates of grazing, if not free. Some of the States have enacted their own grazing regulations. Generally, no grazing rights are recognised as such in reserved forests, though grazing is allowed, with or without fees. In many States the tribals have got rights of free grazing. One of the methods adopted for controlled grazing is the setting up of grazing settlements, as in Madhya Pradesh and Maharashtra. In Madhya Pradesh, however, the method has lost all significance as the State Government has removed all restrictions on the incidence of grazing by cattle belonging to the State.

9.2.50 Grazing *per se* (except for goats) is not inimical to forest growth; in fact, a light grazing improves regeneration conditions, particularly in moister type of forests. However, attempts should be made to prohibit grazing completely in protection forests. In the production forests, grazing can be treated only as a fringe benefit. The provi-

sion of grazing and grass would be one of the primary objectives of social forestry. Where a large programme of grassland development is taken up by the Forest Departments, they should employ an adequate number of agrostologists, agronomists and range management specialists. On no account should such areas be converted later into forest plantations.

9.2.51 Research should be taken up immediately for fixing the optimum carrying capacity of all types of forests including those to be created under social forestry programme. A few upper catchments of river valley projects should be selected for investigation on the effect of grazing on soil and moisture conservation. Agrostologists/agronomists in the State forest research organisations should conduct research in collaboration with the agricultural universities and experts from Agriculture, Animal Husbandry and Sheep Development Departments.

9.2.52 Grazing rules should be promulgated by each State specifying the grazing rates and providing for the manner in which grazing should be permitted, grazing units constituted, carrying capacity fixed, grazing and closure cycle indicated and rules administered. Grazing rates should be upgraded substantially to curb nonessential cattle in forests, though grazing should not be looked upon as a source of revenue.

9.2.53 Grazing should be completely prohibited in the regeneration areas particularly till the plantations are 3 to 10 years old, depending on the particular species and site quality. This factor should be taken into consideration while setting apart grazing settlements. Grasses should be allowed to be cut from these areas and the hay utilised for feeding the essential livestock outside the forests. People owning livestock in the vicinity of wildlife preserves should be persuaded to take to stall feeding, for which permission to cut grass and fodder in a controlled manner may be given.

9.2.54 The improvement and maintenance of grasslands and open forests should be a part of a multidisciplinary approach to the livestock feeds and fodder problem. For the sake of balanced forest development in the whole economy, forest grazing should not be handled as a fringe activity of the organisation created for timber harvesting or commercial forestry. The necessity for creating an extension organisation in the Forest Departments for undertaking all aspects of social forestry has already been stressed. The areas that cannot be covered under social forestry should be developed by the Animal Husbandry Department for additional grazing/production of hay. Grassland development and livestock development programmes should go together so that the grassland development programme becomes an economic

proposition. A State level standing committee should be constituted for proper coordination and implementation. This Committee should be headed by the Agricultural Production Commissioner and should have as Members heads of the Departments of Agriculture, Forest, Soil Conservation, Dairy Development, Sheep Development and Animal Husbandry. The Director of Animal Husbandry should be the Member Secretary of this Committee. Similar coordination committees should be set up at the district level under the chairmanship of the Chief Agricultural Development Officer.

9.2.55 Production forestry being organised on a commercial scale, there may not be much scope for deliberate introduction of fodder trees in such commercial plantations. However, provision should be made in the working plans and project plans for allowing the lopping of fodder leaves in the felling coupes just ahead of the felling. Plantation of fodder trees under social forestry should be coupled with programmes for hay making and ensilage on a wide scale and livestock development.

Forest Based Tribal Development

9.2.56 A large population of tribals live in and around forests. Their welfare should be ensured by satisfying their domestic needs of various forest products and by recognising the priority need of their direct employment in forestry operations. The collection of minor forest produce is one of their principal means of livelihood and this constitutes the main element of forest based tribal development. However, the major problem in the productive uses of forest in some of the tribal regions is the shifting cultivation (*jhum*). Due to the pressure of population and limited forest areas, the cycle gets shorter and shorter and erosion takes heavier and heavier toll, resulting in deterioration of economic conditions of the shifting cultivators.

9.2.57 No dependable statistics of the magnitude of the problem, i.e. number of persons or families practising *jhum* and total area of land under *jhum* annually, are available. It is generally recognised that the problem is acute in Andhra Pradesh, Orissa, Tripura, Meghalaya, Mizoram, Manipur, Nagaland and Arunachal Pradesh. In Madhya Pradesh and Bihar the practice is very limited. Among the attempts made to quantify the problem, the Report of the Scheduled Areas and Scheduled Tribes Commission 1960-61 (Dhebar Commission) concluded that 25.89 lakh tribals depended on shifting cultivation extended annually over an area of 5.41 lakhs ha. The North Eastern Council Secretariat, Shillong estimates that in the north eastern region about 2.7 million ha of forest lands are affected by *jhum* and nearly half a million tribal families are involved. The quantitative aspect of

jhummimg in the States, where problem is very acute, should be determined and the accuracy of the figures for the north eastern region checked. Statistical information of the concerned States should be continuously reviewed through the forest statistical and survey organisations.

9.2.58 A review of the forest policies of different States on shifting cultivation shows that there is hardly any control on *jhum* in forest areas, barring the reserved forests. Both from the points of forest development and economic wellbeing of the tribals, shifting cultivation should be regulated, contained and replaced as expeditiously as possible. The approach to the solution of the problem should be by permanently settling the shifting cultivators, along with a simultaneous programme of afforestation through *taungya* method, pasture and grassland development, and introduction of horticultural as well as plantation crops. Suitable areas in the lower reaches and valley lands and on gentle slopes should be terraced for settled cultivation. In order that no alienation of land takes place in future, the possibility of continued financing of maintenance of terraces and institutional credit arrangements for irrigation, seed, fertiliser, etc. should be ensured. The land tenure system should be set right so that institutional credit can flow to individuals.

9.2.59 It would be necessary to open fair price shops for assured supply of essential commodities at reasonable rates to the tribals including opening of *nistar bhandars* (depots) for supply of domestic requirements of tribals in respect of forest produce. Restrictions would have to be imposed on the rights and privileges of the tribals in the collection of forest produce, such as fuelwood and small timber, where lack of such restrictions may damage the forest.

9.2.60 Settled agriculture should not necessarily be the only guiding policy in regulating shifting cultivation. If pushed too much, sub-marginal lands may be brought under the plough, or steep slopes converted into permanent cultivated fields, leading to serious problems of erosion and consequent impoverishment of the beneficiaries themselves. Because of the limitation in funds and organisation, the time element would be a serious drag in the effective implementation of the programme, and the net effect would be only to create further problems. Hence the need for programme in other sectors which would provide full time occupation to the tribals in the programmes of agri-silviculture, raising plantations crops, development of livestock, etc. Where such programmes are taken up, the tribals should be allotted home-stead land.

9.2.61 Afforestation through agri-silvicultural method would meet for a long time to come the psychological urge of the tribals to practice shifting cultivation. Where commercial production forestry, pro-

gramme is taken up in tribal areas, it should be supplemented by a social forestry programme in parts of forests specially earmarked, and by simultaneous development of minor forest product. Import of labour should be carefully controlled so that adequate and sustained employment goes first to the local tribals. Where industrial programmes based on wood and minor forest produce are taken up, the tribals should be trained for absorption in the concerned forest based industries in the tribal areas and dependence on outside labour should be reduced.

9.2.62 Administrative shortcoming is one of the basic weaknesses in tribal development programme. Adequate use should be made of forest service which has a wide administrative set-up in tribal areas. The Forest Departments should coordinate all activities concerning the problem of shifting cultivation. No programme of economic development of tribals should be formulated or implemented without examining its impact on forest management.

Special Problem Areas

9.2.63 In the Andaman & Nicobar Islands, more than 90 per cent of the land area is under tropical rain forests. It should be possible to base the economic development of the Islands on the forest development programmes. A Forest Development Corporation should be set up in the Islands very early in line with the recommendations in the Interim Report on Production Forestry—Man-made Forests. The organisation under the Chief Conservator of Forests should be strengthened for preparing a production oriented management plan for the forests of south, middle and north Andamans, and a Planning and Project Formulation Cell established for the simultaneous planning of a few chosen existing and new industries. The logging Training Centres Project, Dehra Dun, should prepare logging plans suited to the topographical and environmental conditions of the Islands. Experiences of the mainland are not likely to be of much assistance so far as research information for preparing production oriented management plan is concerned. There is need for industrial and utilisation research. A research centre should be established at Port Blair immediately and, by 1980, converted into a fullfledged regional research institute. Locations should be carefully selected for development of forest and forest based industries, so that these become the focal points of growth for the economy of the Islands. Buildings and other amenities should be provided in a planned way in these selected growth centres, and headquarters of Forest and other Departments should be suitably dispersed in these centres. Arrangements should be made for direct shipping of forest products from the Islands for export to the foreign countries.

Mechanisation of felling and transport, including an efficient system of water transport, should be evolved by arranging expertise from other countries, if required. Information should be gathered about the methods and facilities of loading and stowage of forest products for export by sending a study team to Malaysia and Indonesia. Import of labour should be regulated and the Islands Administration should introduce training schemes for generating skills in the prospective employees of the settler population. So far as forestry personnel is concerned, a mainland posting of officers in the professional grade may be alternated with a posting of the Islands. If this does not work satisfactorily, the possibility of the distribution of the Islands cadre to some of the mainland States for the purpose of exchange of posting may be considered. For running public sector industries and logging operations, employment of retired defence service officers should be considered.

9.2.64 In the cold desert areas of Ladakh in Jammu & Kashmir and Lahaul-Spiti and Hangrang Valley in Himachal Pradesh, future forest development activities should be taken up with the active involvement of the local population, mainly to meet their requirements of fuel, fodder and small timber. Provision of improved fodder for the local livestock through range management and grassland development should have the utmost priority. The entry of migratory graziers should be regulated strictly in accordance with the carrying capacity of the grazing runs. For a large scale afforestation and pasture development programme, a separate canal system with field channels should be constructed. Adequate administrative organisation should be built up. Indiscriminate introduction of species should not be made unless supported by an intensive research effort. Experimentation on conservation and best utilisation of available water should be taken up by the concerned agricultural development department and its findings made available to the forestry personnel for optimum utilisation of water resource. The Government of India should set up a centre for forest research on cold desert at Leh (Ladakh) with an experimental station under it in the Lahaul-Spiti area. Among other things, research should be taken up on improvement of alpine pastures, introduction of legumes, identification of deep rooted quick growing hardy species suitable for fuel and fodder, etc.

Organisation and Manpower

9.2.65 The Centre-State coordination and relationship in the field of forestry has evolved ideally through the institution of the Central Board of Forestry (CBF) and its Standing Committee. The CBF should

meet every two years and its Standing Committee should be more effectively used. The Central Forestry Commission (CFC) provides technical, administrative and secretarial support to the CBF. The strength of the CFC should be augmented so that it can function effectively as a permanent coordinating body at the professional and technical level, in addition to providing the necessary support to the CBF. However, some of its functions, like conducting market studies on forest products and rendering advice to the States in implementation and evaluation of the forest development programmes, should be assigned to the national forest survey and planning cell organisations respectively at the Centre.

9.2.66 Forestry is looked after in a Division in the Union Ministry of Agriculture and Irrigation and is headed by the Inspector General of Forests (IGF) with the *ex-officio* status of Additional Secretary to the Government of India. Since the detailed formulation of the policy, planning and execution of programmes, as recommended, would enormously increase the workload at the Centre, there should be a Department of Forestry in the Union Ministry to deal with production forestry, social forestry, wildlife and forest research and education, with the IGF as the Secretary incharge.

9.2.67 The department should have three divisions, with clearly defined functions, each in charge of an Additional Inspector General of Forests, *viz.*,

- (i) Division of Forest Inventory, Planning and Evaluation with two wings : (a) national forest survey and (b) planning cell.
- (ii) Division of Wildlife.
- (iii) Division of Forest Research and Education with three wings : (a) wing of forestry, forest biology, forest management and operations researches, (b) wing of industrial and utilisation researches, and (c) wing of forest education and training.

In order that the Divisions can function with the greatest flexibilities, the Additional IGF's should be made Additional Secretaries to the Government of India.

9.2.68 The Chief Conservator of Forests (CCF) at the State level should function as Secretary to the State Government. Where there are more than one CCF in a State, the principal CCF should be accorded that status. While there cannot be any uniform pattern of administrative set-up in the States, because of the wide difference in the availability of forest resources, an adequate organisational support with personnel of appropriate status should be built up to deal with production and social forestry, development of MFP, management of wildlife and national parks, forest protection, forest inventory, planning and

evaluation and forest research and training. Forest development corporations, as envisaged, would look after commercial production forestry and for development of minor forest produce.

9.2.69 The average size (150,000 ha) of a forest division, the lowest accounting and administrative unit, is too large for intensive management and utilisation of forest resources. Each State should set up a committee under the CCF to fix norms for delimiting circles, divisions, sub-divisions, ranges, etc., both for territorial and nonterritorial charges. In doing so, special functions of planning, utilisation, wildlife management, research and education etc. should be taken into account.

9.2.70 The hierarchy in forest management has been built up through the following well organised services :

- (i) Indian Forest Service;
- (ii) State Forest Services;
- (iii) Forest Rangers;
- (iv) Deputy Rangers/Foresters;
- (v) Forest Guards.

With the anticipated delimitation of territorial charges and intensification of work through forest corporations, more personnel would be required for territorial and functional charges. Consistent with the average size of a territorial division to be brought down to, say, 50,000 ha, the requirements of forestry personnel are likely to be as in table below :

Table 9.3
Projected Requirement of Forestry Personnel

Category	Staff in position in 1972	Projected requirement			
		1980	1985	1990	2000AD
Higher professional staff .	2,267	3,400	4,550	6,100	11,000
Forest Rangers and Deputy					
Rangers . . .	6,958	10,450	14,000	18,750	33,550
Foresters . . .	18,189	27,350	36,600	49,000	87,700
Forest Guards . . .	53,942	66,300	76,900	89,150	119,850
Game Keepers and others	12,444	18,700	25,050	33,500	60,000
Total . . .	93,800	126,200	157,100	916,500	312,100

Augmentation of the education and training facilities, based on the above projections should be planned somewhat ahead of the period in which the personnel are required to be in position.

9.2.71 Forestry is an important source of employment in the rural areas. The employment available in this sector is often in the off-season and is, therefore, complementary to the employment in farm production. As forests are located in backward areas, direct employ-

ment in forestry activities can benefit the backward communities, such as tribals. Besides, activities in the forestry sector require a very high component of unskilled labour and would, thus, benefit primarily the unemployed and underemployed agricultural labourers and weaker sections of the rural community. However, the employment in forestry should be considered as alleviating seasonal unemployment and/or underemployment, and contributing to an increase in the income level of rural households, rather than be projected as full-time employment for a certain number of persons.

9.2.72 The generation of employment opportunities in forest development activities are associated with : (a) production forestry; (b) social forestry; and (c) minor forest products. With regard to production forestry, the related activities are logging, road construction and regeneration. According to the represent quantum of employment generation, the employment in 1970 in different aspects of production forestry was about 280 million man-days and is expected to rise to about 830 million man-days in 2000 AD. The employment in social forestry in 1970 was about 180 million man-days and is expected to rise to about 810 million man-days in 2000 AD. The employment to be generated by development of minor forest products has been dealt with in the next section.

3 MINOR FOREST PRODUCE

9.3.1 Minor forest produce/products (MFP) include all products obtainable from forests other than wood. Many of these are indispensable requirements of the population, particularly of those who live in or near the forests. Also, there are cottage, small and medium sized industries where certain MFP are processed. Some of the products in this category constitute a significant part of the commodity for export. There is a great potential for these products to contribute to the economy of the nation and as such the strategy for forest development should include a programme for increasing production/collection and utilisation of MFP as an integral component of the total forest resources.

Production—Actual and Potential, Demand, Collection and Processing

9.3.2 The contribution of MFP to the total revenue of the Forest Departments in India has been about 30 per cent in the period 1967-70. According to the "National Accounts Statistics, 1960-61 to 1972-73—Disaggregated Tables", the gross value of output from MFP during 1969-70 was estimated at Rs 108.08 crores at current prices. Reliable statistics of outturn of various kinds of MFP are not available. As a result the Indian Forest Statistics do not give data on the produc-

tion of MFP in physical terms; only monetary values are given. Again, the quantities given away free or at concessional rates to villagers and rightholders are rarely calculated with any accuracy. Subject to the above limitations, the estimates of production of, and demand for, a few items of MFP, have been made, based on studies made by different agencies as well as from records maintained in FRI.

9.3.3 In the matter of fibre and flosses, good scope exists for planting sisal hemp (*Agave sisalana* Perrine) in fire lines, nursery and plantation boundaries, clearances under transmission lines, etc. However, it would not be desirable to raise plantations of agave in areas available for raising tree plantations. Kapok [*Ceiba Pentandra* (Linn.) Gaertn. syn. *Eriodendron anfractuosum* DC.] trees for floss are at present planted abundantly in Kerala and adjoining tracts. This should be encouraged in concentrated patches in high rainfall areas to make collection of kapok floss economical. Canal banks, roadsides, edges of plantations and other such areas lend themselves for such concentrated kapok plantations.

9.3.4 About 80 per cent of bamboo produced is utilised in ways other than in industries. The present methods of exploitation are far from satisfactory. In the interest of meeting the agricultural, commercial and industrial demands to the maximum extent, it would be desirable to systematically survey the bamboo bearing areas to determine their present production and work them strictly accordingly to silvicultural practices to get the maximum sustained yield.

9.3.5 Essential oils are produced from a large variety of MFP, like lemon grass, eucalyptus leaves, *rusa* [*Cymbopogon martinii* (Roxb.) Wats. var. *motia*] grass, citronella grass etc. The production in 1972-73 was 1,475 tonnes, of which 420 tonnes were exported. India also imports about 480 tonnes of essential oils annually to meet the demand of the industries. Demonstration plantations of oil producing grasses, but on commercial considerations, should be taken up. The development of industries with respect to production of essential oils should be encouraged. While the ICAR would be responsible for plant research, research on industrial processing should continue to be the responsibility of the Central Indian Medicinal Plant Organisation under the CSIR. The FRI, however, should continue to deal with the multiplication and distribution of seed material of the plants of forest origin.

9.3.6 One of the most important essential oils is sandalwood oil obtained by distillation of heartwood of sandal. The regeneration problems of sandal should be effectively tackled through afforestation programme in sandal bearing areas, and the possibilities of growing sandal in other parts of the country explored. The research on sandal

spike disease should be intensified. Export of sandalwood billets should be gradually reduced and, instead, distillation of oil and the products of cottage industries based on sandalwood carving developed for export. There should be a uniform legislation on the possession and transit of sandalwood applicable to the concerned States in order to prevent smuggling and theft of this very important wood.

9.3.7 In recent years, production of cultivated oilseeds has been far short of the demand. There is a need for looking into other sources to bridge the gap between the demand and supply. Seeds of certain trees contain oil. Some of these, like *mahua* [*Madhuca longifolia* (Koenig) MacBride] and *neem* (*Azadirachta indica* A. Juss) oils, are already established industrial raw materials. Others like *karani* [*Pongamia pinnata* (Linn.) Pierre] and *kusum* [*Scheichera oleosa* (Lour.) Merr.] have come into large scale use in recent years. The efforts to exploit *sal* seeds as a source of vegetable oil have started bearing fruit since 1968. In fact, a most recent remarkable development in the use of minor oilseeds of tree origin has been in the case of *sal* seeds. There are other forest trees and shrubs, on the seeds of which research and development work is needed.

9.3.8 The production of oil from the cultivated oilseeds was hardly 59,000 tonnes in 1970-71. Considering its potential, a target of production of 1.2 million tonnes of oil by 2000 AD is possible through the use of *Mahua*, *neem*, *karani*, *kusum*, *sal*, *khakan* (*Salvadora deoides* Dcne), *kokam* (*Garcinia indica* Chois.), *nahor* (*Mesua ferrea* Linn.), *undi* (*Calophyllum inophyllum* Linn.) and various other miscellaneous oilseeds of tree and shrub origin. Incentives should be given, as found necessary, to the industries for using larger quantities of minor oilseeds, particularly in soap making. Simultaneously, extension efforts should be directed towards popularising the deoiled *sal* meal for cattle and poultry feed.

9.3.9 A variety of vegetable tanning material is produced in the forests, the chief being the myrabolan, particularly *harra*. A survey of *harra* tree (*Terminalia chebula* Retz.) should be taken up with a view to making an estimate of the production of myrabolan. Experiments regarding the successful raising of myrabolan plantations mixed with other species should be undertaken. Plantations of exotic species, like wattle and *Schinopsis lorentzii* Engl. should be extended for supplementing resources for tanning production. Well organised factories for the manufacture of tanning extracts from all tanning yielding materials should be set up as early as possible to maximise the earnings from exports.

9.3.10 *Katha* rich in catechin, is an important dye obtained from *khair* (*Acacia catechu* Willd.) heartwood. For its manufacture,

availability of raw material of required specifications and in quantities and within economic lead should be assured over a period. Steps should be taken to take up a more scientific method of production to reduce wastage.

9.3.11 There are several species of trees from which gum is collected and marketed in India and abroad. One of the most important gums with a large export potential is gum *karaya* obtained from *Sterculia urens* Roxb. To increase the production of gum from existing natural resources, the methods of collection have to be improved. Future availability may be increased by raising new plantations.

9.3.12 The most important resin is that obtained from tapping *chir* pine (*Pinus roxburghii* Sargent) and *kail* or blue pine (*P. wallichiana* A.B. Jackson) occurring in the western Himalayan forests. It is a flourishing forest industry. The estimate of total production during 1973-74 was about 60,000 tonnes. If processing facilities in Government factories are augmented, products are diversified and exports of resin are increased, the production may be stepped up to 100,000 tonnes by 1985 and 150,000 tonnes by 2000 AD. The present installed capacity, and that immediately foreseen, would not be more than 40 per cent of the possible production of crude resin by 1985. With a view to ensuring increase in export of resin, its quality should be improved by installing modern machinery.

9.3.13 So far as the leaves are concerned, the most important from the commercial point of view are those of *tendu* (*Diospyros melanoxylon* Roxb.) used as wrappers of tobacco to produce *bidi*. It is medium sized tree found throughout the dry forests of the plains, chiefly in Madhya Pradesh and Orissa, and to a lesser extent in Andhra Pradesh, Bihar, West Bengal, Maharashtra, Tamil Nadu, Gujarat, Rajasthan and southern Uttar Pradesh. The annual collection of *tendu* leaves in the country is estimated to exceed 300,000 tonnes, most of which is consumed internally. It has a very short period of collection. The production of good quality *bidi* leaves should be increased and wastage avoided by improving the methods of collection, transportation, grading and storage. Research should be initiated or intensified in relation to pruning/pollarding of trees, pest control, rotational working, regeneration, etc.

9.3.14 Lac cultivation is done by about three million tribal cultivators. The production of sticklac has fluctuated widely in the recent past, being 27,211 tonnes in 1971-72 and 17,038 and 19,258 tonnes in 1972-73 respectively. Since the price of lac is ruling quite high and there has been an increase in international demand, necessary corrective steps to minimise the fluctuations should be taken. The activities concerning lac cultivation and processing should be taken

up as parts of both drought prone areas programme and tribal development programme. Arrangements for marketing and storage of the primary products, namely sticklac and seedlac, should be streamlined. A minimum remunerative price should be guaranteed to the primary producers and broodlac supplied to needy cultivators.

9.3.15 Sporadic efforts have been made to cultivate in the forest areas a few plantation crops like rubber, cashew, coffee, red oilpalm, etc. The policy should be to explore the possibilities of cultivating plantation crops in suitable localities to the extent that it does not interfere with the production of industrial wood. The MFP organisations in the States, particularly in Kerala, Tamil Nadu, Karnataka and Goa should keep this in view.

9.3.16 Efforts should be made to take up wood distillation commercially after making a thorough feasibility study, specially in north eastern India and Bastar region of Madhya Pradesh, where extraction of fuelwood is uneconomical. Research and development of machinery should be intensified in the FRI and regional research laboratories of the CSIR.

Export

9.3.17 The average export earning from minor forest produce for the period 1971-72 to 1973-74 had been about Rs 27.63 crores, of which lac and lac products accounted for maximum earnings, i.e. 32.78 per cent. The next important groups is plants, seeds, etc. used in perfumery, pharmacy, etc. constituting 24.20 per cent. Psyllium husk contributed 10.02 per cent in this group. Natural gums, resins and balsams accounted for 20.02 per cent, of which gum *karaya* alone contributed 14.06 per cent. While the essential oils accounted for 16.90 per cent of total export earnings, sandalwood oil itself contributed 10.74 per cent in this group.

9.3.18 An analysis of the main markets of minor forest produce shows that not only are the items traditional but so also are the markets. Western Europe and North America remain the most important regions from the point of view of export. The average unit value has, however, risen steadily, except in 1972-73, in respect of MFP exports to Western Europe and North America.

9.3.19 The existing capacity for crushing myrabolan in India is grossly underutilised. However, if the production of tannin extracts can be augmented and export of tanned leather increased, it is not necessary to aim at a high quantity of crude myrabolan export. In the case of gum *karaya* about 50 per cent of the quantity was exported to USA with another 30 to 33 per cent to Western Europe during 1969-

70 to 1973-74. Its export, both in quantity and value has reached a plateau and future growth of exports is quite uncertain. The organisation at the all India level for export promotion and the State MFP organisations should undertake a study of the problems of increasing its exports. It would be necessary to extend scientific tapping methods in the case of this product.

9.3.20 In the case of lac and its products, there was a gradual drop in quantity exported from 1969-70 onwards with a sharp drop in 1972-73, and 1973-74. From 16,739 tonnes in 1969-70, the quantity exported in 1973-74 has come down to 5,608 tonnes. The unit price has, however, risen steadily from Rs 2.85 per kg in 1969-70 to Rs 25.67 per kg in 1973-74. The shortfall in the quantity of export was not due to any sudden shrinkage of overseas demand but was largely due to a shortage in production because of unremunerative prices paid to the cultivators/collectors. For promoting production and export earnings from this source, it would be desirable to have a stable and continuing production base. More concentrated efforts should be made to develop widely varied markets of export of lac and its product. Benefit of increasing export prices should be passed on to the cultivators/collectors. Cultivating, processing and marketing should be considered as an integral industrial venture.

9.3.21 While considering traditional items of MFP for export, greater attention should be paid to identify traditional markets for each of the produce. Market intelligence should be collected from abroad. Agmark standards for all important items of MFP should be developed to ensure confidence in Indian products. A preshipment inspection by the national export organisation should be made compulsory. Amongst the nontraditional items, greater efforts should be made for increased export of resin, gum *ghatti* (obtained from *Anogeissus latifolia Edgew.*), *kuth* (*Saussuria lappa C.B.C1.*) root, *nux-vomica* (*Strychnos nux-vomica Linn.*) dried ripe seed, sandalwood chips and dust, palmarosa oil and vetiver oil.

Organisation

9.3.22 At present, the MFP is, by and large, collected and marketed through private contractual agencies. The main shortcomings considered in collection and marketing are summarised as below :

- (i) Most of the minor forest products occur in widely scattered areas and in difficult and inaccessible terrain, making economic exploitation difficult.
- (ii) Some of the products are perishable and available only for a short season. Their timely collection and storage assume great importance.
- (iii) Collection is resorted to from the forests in the vicinity of villages, while it is generally neglected or ignored from

the interior forests.

- (iv) At the time of collection, hardly any attention is paid to the procurement of good quality material. Adulteration, with motive of larger gains, is practised at all levels.
- (v) Unscientific methods and overexploitation result in dwinging of production and scarcity of the product.
- (vi) The collectors, who are mostly tribals, do not get either sustained employment or reasonable remuneration in the present system.

9.3.23 In order to overcome the shortcomings, it is necessary to modernise the institutional and organisational setup for the procurement and the utilisation of the MFP. The States with sizeable resources of particular product, or groups of products, may each set up a Minor Forest Products Corporation. In other States, it would be desirable to have a separate forest circle devoted exclusively to this work. Collection should be arranged through normal field staff of the Forest Departments and they should be paid honoraria for the purpose.

9.3.24 The actual collection, and at least the initial processing, of minor forest produce should be done either by direct recruitment of labour or through labour cooperative societies, and the system of intermediaries should be abolished. Labour should be trained in proper and methodical collection, quality control and grading. The trained labour should be encouraged to form labour cooperative societies. Forestry personnel should be trained in marketing strategy.

9.3.25 The survey of minor forest produce by the State inventory organisations should aim at collecting data on the distribution, processing, grading, storage, transport, marketing, prices, utilisation, etc. Wherever corporations have come to be established, they should promote and simultaneously extend financial support for such investigation.

9.3.26 Nationalisation should be resorted to in respect of trade in certain products, like *tendu* leaves, sandalwood, gum *karaya*, bamboo, myrabolan, resin, etc., Sandalwood oil industry should also be nationalised.

9.3.27 There should be an organisation at the all India level for tackling different matters connected with export of minor forest produce, particularly for ensuring quality control, undertaking market research and export promotion, and gathering and disseminating information on production costs and sale price.

Employment

9.3.28 The MFP development, which has a substantial employ-

ment content, covers *tendu* leaves, resins, gums, tannin, medicinal plants, essential oils, bamboos, grasses, lac, honey, etc. The utilisation of minor oilseeds of tree and shrub origin also offers considerable scope for additional employment. Calculating on the basis of the contribution of MFP in terms of value to the gross value of output, and assuming that 75 per cent of it is contributed by the wage component, the employment in 1970 works out to 250 million man-days. With proper investments and organisational support, on the lines recommended earlier, it should be possible to increase rural employment in MFP operations to 1000 million man-days by 2000 AD, practically the entire employment going to the backward classes. Cash payment of wages to the collectors should be made, but linked to production with quality checks by way of sample testing in terms of yield of final products. Incentive plans should be prepared to get higher collection and better quality of products.

4 FOREST ECOLOGY AND WILDLIFE MANAGEMENT

9.4.1 The economic needs of man dictated the felling of more and more of the forests to grow more food and extracting more and more of timber for use as raw material for industries. But very often the exploitation of water, soil and vegetation resources was done without acquiring sufficient knowledge of the ecological impact of different types of agricultural, silvicultural and pastoral landuse. Enough care was not taken in replacing the resources, even where it was possible to do so, as in the case of forests.

Forest and Environment

9.4.2 The beneficial effects of a forest ecosystem on human environment consist in moderating the climate, maintaining the soil mantle, regulating the water supplies, purifying the air and helping in noise abatement. The forests also provide recreation. They represent a storehouse for preserving the gene pools of species of plants, animals and micro-organisms. They provide a habitat for wildlife and important elements of environment.

9.4.3 Factors responsible for degradation and deterioration in the forests fall under the following broad groups : (a) disforestation; (b) defective methods of landuse, (c) fire, (d) insects and diseases, (e) pollution of environment; and (f) natural factors. While the natural factors, climatic or otherwise, causing deterioration and degra-

dation are in part uncontrollable, their vagaries can be minimised for both economic and ecological gains by proper management techniques. The problems of landscaping are different in different types of forests and can be considered under the three main functional attributes of forestry, e.g. protection forestry, production forestry and social forestry.

9.4.4 As regards protection forestry, the forest management should give due importance to the consideration of ecology by creating protection forests, preservation plots and protected trees, Nature reserves and wilderness areas. Such areas, where even the slightest disturbance of the forest cover is undesirable, should be classed as protection forests. It will be useful to compile a list of purely protection forests for each State and Union Territory. Other forests in mountain system and river valley catchments can, and should, be developed and managed simultaneously both for production of timber and for environmental values. The total number of preservation plots in India is 188 and the area occupied by them totals 8,422.35 ha. The smallest one is 0.01 ha and the largest 4,000 ha. The coverage of preservation plots, both as regards subtypes represented and area under each subtype should be increased to attain a fair percentage of all the recognised subtypes. A list of protected trees in the country should be prepared by the FRI and deficiencies discovered regarding coverage of important species should be made good by joint action of the State Forest Departments and the FRI. Nature reserves are much larger areas than preservation plots and cover several forest types. The Forest Departments should demarcate at least a few Nature reserves to preserve forest areas and wetlands under virgin or near virgin conditions.

9.4.5 So far as production forestry is concerned, the development of various silvicultural systems in forest management has followed the increase in demand for wood in various forms and sizes, on the one hand, and the need to adjust operations under these systems to the ecological characters and the site and the silvicultural requirements of the species, on the other. A safeguard against likely environmental ill-effects is the correct identification of programme area. The various alternatives in the choice of species, plantation techniques, spacing, mixture, tending, rotations and protection should be decided not only with reference to short term and economic considerations but also from the larger and long term view of their effects on the ecosystem. For instance, both in coppice and clearfelling systems and the shape and size of the coupes could be kept in balance with the physical features of the land. Natural forests may be left between successive coupes and along natural features, such as ridges, streams and depressions and also a few unfelled groups here and there.

Ecological Considerations in Forestry

9.4.6 There is much common ground between social forestry and environmental forestry. However, for creating better aesthetic effects along with meeting other demands through extension forestry on the sides of roads, canals and railway lines, it should be possible to plant up in multiple rows. Suitable species, like *Ficus* trees, *neem* etc. should be introduced along with other quick growing species so that these trees can provide food to the birds which would otherwise descend on the cultivated fields.

9.4.7 The design and setting of structures in national parks and wildlife sanctuaries and Nature reserves should be put up for approval by the Indian Board for Wildlife (IBWL) or the State Wildlife Advisory Board concerned before any construction starts. In particular, care should be taken not to build multistoreyed or large concrete structures that do not merge well with the surrounding forests. All private advertisements in the forests should be prohibited and the signboards of plantations etc. should be small and inconspicuous and so fixed as not to obstruct the natural features.

Wildlife Development

9.4.8 Wildlife (Protection) Act, 1972 passed by the Parliament defines wildlife to include "any animal, bees, butterflies, crustacees, fish and moths and aquatic or land vegetation which forms part of any habitat".

9.4.9 The population of wildlife is critical except in national parks, sanctuaries and closed areas. Even in these areas, there are only a few pockets where the animal population can be called optimum. A few forms of wildlife have reached a critical stage of shortly becoming extinct unless immediate remedial measures are taken.

9.4.10 The 1972 Act governs wildlife conservation and its protection both inside and outside the forest areas. The States which have not adopted the Act should be persuaded to do so. All the species of wildlife listed as threatened with extinction in the Report of the Expert Committee of the Indian Board for Wildlife—Wildlife Conservation in India (1970) have not been included in Schedule I of the Act. This should be done to give them complete protection. Big game should be brought under the list of protected animals for at least five years and their exploitation should be only for scientific purposes. The Act should also be amended to include a provision for constituting the IBWL, with adequate representation of the State Wildlife Advisory Boards on it.

9.4.11 The coverage of wildlife preservation areas, national parks and sanctuaries should be extended to cover the remaining major forest types, where there are no wildlife preservation areas at present. The boundaries of the national parks and sanctuaries should have sufficient buffer zones to cover the range of movement in these areas. Growing and collection of forest produce should be prohibited in the core areas which should form about four per cent of the forest land distributed among varied natural conditions and ecological associations.

9.4.12 The game areas outside national parks and sanctuaries should be divided into convenient shooting blocks or shooting reserves depending on availability of games, etc. Availability of all forms of wildlife in each shooting block should be assessed periodically so that game in excess of an optimum genetically viable number may be fixed for cropping. There should be uniformity with regard to game rules and regulations at least in contiguous blocks of forests, if not over the whole country. The close season should be uniform as far as possible, and the reproductive biology of the game animals should be taken into account for fixing the close season. Model rules should be drafted by the Central Government to regulate hunting licences, close seasons, payment of fees, bag limits, etc. The object of habitat management for wildlife should be to have as large a population and as varied a composition as is compatible with the carrying capacity of the habitat. To coordinate forest management with that of wildlife areas, the forest working plans should recognise the conservation and scientific management of wildlife in all forest areas as one of the general objectives of management.

9.4.13 For administration, management and conservation of wildlife, the State Governments should establish a separate wildlife wing in the Forest Departments directly under the Chief Conservators of Forests as recommended by the IBWL. The strength of the wildlife wing in each State should be adequately built up for effective wildlife conservation in areas inside and outside the forests. The personnel in the wildlife wing should directly manage the national parks and sanctuaries, and dual control by having a separate territorial staff or officer with overlapping wildlife staff should be eliminated. In the rest of the forest areas, the territorial staff should be responsible for wildlife management. The State forest corporations should be responsible for development and management of wildlife in areas transferred to their control. Their requirement of staff for development of wildlife and recreation should be obtained from the wildlife wing of the Forest Departments.

9.4.14 Master plans for at least 10 years should be prepared for wildlife management and the plan allocations channelised on needbased

priorities to the schemes so drawn up. It would be worthwhile to raise trust by taking donations for financing selected projects of national importance aimed at conservation of selected species likely to become extinct. The serious position in the depletion of tigers has already led to the initiation since 1973-74 of 'Project Tiger', to which the International Union for the Conservation of Nature and Natural Resources and World Wildlife Fund have contributed.

9.4.15 Suitable forestry personnel or outside specialists should be selected for entrusting them with specific wildlife research projects. A strong research cell in the FRI should be set up and in each State there should be adequate wildlife research personnel. Short courses on wildlife and environment should be devised for all levels of forestry personnel. Undergoing such courses should be compulsory for the personnel to be inducted in the wildlife wing. Staff for this purpose in the FRI should be suitably augmented. All the professional training institutes dealing with landuse, e.g. agricultural universities, etc. should include in their training programme a few lectures on environmental conservation. Postgraduate interdisciplinary courses of study for vocations in the field of natural resources should be opened in more and more universities. The Banaras Hindu University has already got a course of M.Sc. in resources ecology and Tamil Nadu Agricultural University in environmental biology. At the school and college levels, the syllabi should be suitably modified for incorporating environmentalist ideas. A group of teachers should be trained through short courses in environmental concepts to further train batches of teachers.

Diseases of Wildlife

9.4.16 Diseases are one of the major decimating factors causing mortality among wild animals. The methods of detection and prophylactic treatment of diseases among wild animals are extremely inadequate. For devising preventive measures, a survey of major diseases affecting wildlife and an investigation on the importance of stress in causing or accentuating disease conditions among wildlife as commonly occurring infectious and deficiency diseases among wild animals in captivity, should be organised in collaboration with the Indian Veterinary Research Institute (IVRI) and the agricultural universities.

9.4.17 Experienced veterinarians in each State Veterinary Department should be trained in diagnosis and prophylactic treatment of diseases among wildlife. Every national park/sanctuary should employ qualified veterinary staff to look after the work of prevention and treatment of diseases of wildlife. The forest officers concerned with wildlife management should be trained for a short period in the aetiology and

symptomatology of the commonly occurring infectious diseases of wildlife.

Wildlife and Tourism

9.4.18 Hitherto, the emphasis in India had been on development of tourism based on its historical and cultural assets. To this, recently, a new dimension has been added—that of wildlife tourism. It has, however, to be ensured that the natural areas being developed are not spoiled by overvisitation. For developing wildlife tourism, a few selected national parks and sanctuaries should be set up in special category areas, e.g. marine, mountain and desert, to effectively preserve and display the typical habitat of these areas and their characteristic fauna and flora for the purpose of tourism and research. The State authorities should be actively involved in wildlife tourism development effort.

5 FOREST PROTECTION AND LAW

9.5.1 Forest protection covers the activities designed towards the prevention and control of damage to forests by man, animals, fire, insects, diseases or other injurious and destructive agencies. The primary forest protection problems are in respect of forest grazing, fire, theft and encroachments. Forest grazing and insects and diseases have been dealt with earlier. For the protection of forests, Forest Acts were formulated and revised from time to time. The compulsion of the time and State responsibilities continue to create new situations requiring a new look at the forest laws.

Forest Fire

9.5.2 The forest fire is one of the most potent sources of damage to the forests. With a view to planning fire prevention measures it is important to ascertain, and maintain an authentic record of, the causes of forest fires. A uniform classification of forest fires by types and causes should be evolved and adopted by all the States. There should be a well planned fire protection organisation in the States, particularly in those having fire-prone forest areas. Specially, it will be necessary to develop an efficient system of fire protection to safeguard the investment in man-made forestry. With the setting up of such an organisation the compilation of statistics on fire would be relatively easy for classification and report.

9.5.3 Man-caused fire can be prevented if the local population realise the direct and indirect benefits of forests and the resultant losses accruing to them from fires. Letters of appreciation and cash rewards to the local *panchayats* and voluntary associations could be an effective tool for their cooperation and assistance in fire-prone areas. Publicity for protection of forests from fire should be ensured both among urban and rural groups of population, particularly by an imaginative use of the audiovisual medium. The practice of engaging local people in the lookout stations for detection and suppression of forest fire should be widely adopted, but the continuance of the job should be related to performance.

9.5.4 In addition to building up a reliable communication and transport system, fire breaks and fire lines, there should be a provision for the award of enhanced punishment in the case of wilful fire damage to a forest. Provision for summary trial of offences relating to forest fires may be made. In case of repeated man-caused fires, the Government may suspend rights and privileges of the community.

9.5.5 Training programme in fire detection, prevention and suppression should be arranged for all levels of field officers. A research project involving the States with fire-prone areas should be evolved and Centrally coordinated by the FRI. The FRI also develop the concept of "fuel types" to guide the preparation of maps to show the fuel condition in all fire-prone areas previously identified.

Protection from Destruction and Encroachment

9.5.6 A specific class of people is allowed to collect some forest produce for bona fide domestic and agricultural purposes, either free or at concessional rates. The most widespread and common terminology is forest *nistar*. In view of the diminishing production due to overexploitation and uncontrolled grazing, it has become necessary to control *nistar* in such a way that the deserving people get their essential requirements conveniently and at reasonable rates without impairing the productivity of the forests. The villagers should not be allowed to collect *nistar* themselves from the forests. Instead, *nistar bhandars* (depots) may be established at convenient places by the Forest Departments for meeting the bona fide requirements of the people, and a charge to include the cost of production, transport, depot charges as also a nominal profit should be made. Ultimately *nistar* should be abolished. Where necessary as in interim measure, separate areas of forests should be set aside as far as possible for meeting the *nistar* demand. The association of *panchayats* for protection of *nistar* forests should be

secured. Once *nistar* forests are demarcated, no rights and privileges should be allowed in forests reserved for production forestry and for conservation of nature or environment. Where disforestation takes place, *nistar* rights should be proportionately abolished.

9.5.7 All unclassed and protected forests should be constituted into reserved forests at the earliest, in order that *nistar* could be abolished as far as possible in the manner provided in the forest law. Wherever the *nistar* demand is acute, wastelands available nearby should be utilised for producing fuel and hay as also other products considered indispensable by the *nistar*s.

9.5.8 Unauthorised removal from forests takes place mostly because there is unemployment and underemployment in the rural sector and the only living to be earned, or family income augmented, is by way of unauthorised removal of fuelwood and small timber and sale in the semiurban or rural market places. In order to get effective cooperation from the people it would be necessary to involve the villagers directly in forestry operations. As far as possible, no sale of timber standing in the forests should, therefore, be made. Logging should be done departmentally by employing local labour directly or through their cooperatives. To protect the forest from destruction and unauthorised encroachment, more employment opportunities should be created in forest operations. This would require sufficient allocation of funds for forest development and a rethinking in the order of priorities for financing forest development schemes.

Present Status of Forest Laws

9.5.9 An Indian Forest Act was legislated in 1865. After several amendments, a comprehensive Forest Act was enacted in 1927. At present either the Indian Forest Act, 1927, with or without modifications, is applicable to different States, or State Forest Acts mainly on the pattern of the 1927 Act have been formulated. In some parts of the country, Madras Forest Act, 1882 is also in vogue. The question of revision of the 1927 Act been examined by the Central Board of Forestry (CBF) and in 1973 and CBF recommended revision of the Act.

The Approach to Forest Legislation

9.5.10 The accent in the suggestions as well as in the State Forest Acts is on remedial, preventive and punitive measures. The conditions in India are such that there cannot but be a relatively more emphasis on preventive and punitive aspects and enhancement of pena-

lities in forest law. The following principles, which should govern the revision of forest legislation, should be adopted :

- (i) There should be uniformity in forest laws, so that incompatibility of forest laws among the States is removed and there is no multiplicity of legally sanctioned authorities concerned with forestry matters.
- (ii) It should be possible to tackle specific problems in different parts of the country through subsidiary rules and regulations, where permissible.
- (iii) A developmental approach should be followed.
- (iv) There should be stringent preventive and punitive provisions, so that when a resource is allocated for development in a certain direction, it is not wasted.

9.5.11 Even though forests is a State subject, a revised all India Forest Act should be framed, instead of amending any existing Act, and enacted by the Parliament for the sake of uniformity. It should be possible to frame the Act in such a manner that the States are free to make subsidiary rules and regulations under the Act to tackle any special situation.

9.5.12 There should be provision in the Act for setting up a national/regional agency for rational use of forest resources both for internal use and for export. A provision should also be made that no deforestation should be permitted without the approval of the State Legislatures and that where some diversion of forest land for other uses become inevitable, attempts should be made by bringing some other area under forest. The preventive and punitive provisions should be made more stringent and enhancement of penalities should be provided for the more severe types of offences.

6 FOREST PLANNING, RESEARCH AND EDUCATION

Forest Inventory

9.6.1 A wealth of resource and resource-oriented information already exists in India in the form of forest working plans, census reports, industrial output statistics, soil survey reports, etc. However, most of this information is not readily retrievable, lacks uniformity and is difficult, if not impossible, to be made use of in the planning of forest development. It is to be ensured that in future all information collected for working plans etc. can be readily aggregated for national inventory and planning purposes, which means that a common set of definitions, terminology, measurement units and standards

should be developed and created at all levels.

9.6.2 The Pre-Investment Survey of Forest Resources (PIS) is limited to a survey of forest resources for industrial utilisation in previously identified industrial catchments based on existing information. A survey on national scale of a more generalised nature should be a precondition for deciding priorities for the selection of areas for detailed pre-investment studies. The draft Fifth Plan envisages the conversion of the present PIS into National Forest Survey organisation for carrying out regular, periodical and comprehensive forest resources surveys. Such an organisation should be built up by expanding the existing PIS and its programme should encompass : (a) resource analysis; (b) current and prospective supply of goods and services; (c) current and prospective demand for goods and service; (d) technical support services (data processing and biometry); and (e) methodological development. There should be an Advisory Council at the Centre to advise on the policy of forest surveys and priority to be assigned by the National Forest Survey organisation and to secure necessary coordination with the concerned industries. In addition, there should be regional technical committees, one for each region, to decide the details on technical working, interrelationship of forest surveys with local plans and connected matters and to suggest priority for surveys.

9.6.3 Appropriate forest maps on suitable scales according to the intensity of management are essential for the management of forest resources. For working plans, particularly in areas where fairly intensive forest management is being practised, it is necessary to have maps on 1 : 15,000 or 1 : 25,000 scales. For normal forest management purposes, aerial photographs on 1 : 50,000 scale would suffice. In areas of special interest and for those intensively managed or under man-made forests, aerial photographs should be on 1 : 20,000 scale.

9.6.4 For analysing current and prospective supply, some kind of permanent plot system, that can be measured in part or in entirety over different periods, should be established. Systematic sample and continued use of clustered ground sample should be used. Each unit in a cluster should cover a relatively large area. Adequate information should be collected on growth, mortality, cull, increment and removal rates, as also data for pricing of future timber supplies. Changes and trends in wood use over time, as well as absolute amounts should be determined, and this information should be used along with census data etc. to make estimates of aggregate present and future wood requirement. An iteration between supply and demand at various price levels should be done. While the coverage, accuracy and break up of the data for different levels would be different, there

should be a common layout and format so that data could readily flow from the district or project level to the State and regional level, and then to the national level.

Forestry Statistics

9.6.5 Besides the aspects of forestry statistics that would be covered under forest inventory, many more statistics have to be collected by the agencies entrusted with the responsibility of forest management, compilation of working plans, project planning etc. Standardised form for compilation of forestry statistics have been prescribed by the Directorate of Economics and Statistics (DES) in the Ministry of Agriculture & Irrigation, Government of India. Timely availability and reliability of the statistics can be improved by rationalising and simplifying the proformae. The standard forms for collection of forestry statistics should be revised and regrouped into : (a) periodic forestry statistics, and (b) annual forestry statistics. The collection of periodic forestry statistics should be so organised that the data collected prove useful for formulating the five year plans. Annual forestry statistics should be collected from different sources.

9.6.6 A great deal of discrepancy exists in the statistics of area under forests as given out in the Indian Agricultural Statistics and the Indian Forest Statistics. The Chief Conservators of Forests and the crop reporting authority at the State level should get together and take steps to resolve the discrepancy. Clearcut procedures should be laid down for updating the records every year and publication of one set of figures by both the agencies.

9.6.7 Production statistics returns should not only show the class of products as it leaves the forests but also the subsequent products after conversion. Pulpwood requires to be shown separately and not aggregated with roundwood or any other kind of wood. The concept of value of timber, fuelwood and minor forest produce and the markets needs to be elaborated. Since there are many ways of disposal of produce, major or minor, the point at which value is to be reckoned should be clearly defined by the State Forest Departments in consultation with the State statistical bureaus. For consumption statistics, movement of forest produce from one State to another should be reported on the basis of sample studies in each sector of the industry. Price and cost statistics should be improved in quality and scope, enabling a more correct statement of income from forest and logging. Detailed data of labour employment in various forestry activities and forest industries should be collected and assessed. For coordination and linking of forestry activities with other activities in the district, the

data from the forest divisions should be collected in such a manner as to enable them to be split or combined by districts.

Forestry Planning

9.6.8 The forest management so far has not aimed at any national production programme in the forestry sector for meeting the requirement of the entire population. Forestry production outside the reserved or protected forests, although substantial, did not find any place in this management. Forestry production also includes services from the land in the form of protection, recreation or other environmental values. All these together should form the national production goal.

9.6.9 The planning strategy should aim at providing the necessary forest goods and environmental services to the growing population at the centres of utilisation based on the production capacity of the available lands, both in the forestry and nonforestry sectors. Thus, planning for fuelwood would be of mostly local nature, whereas that for industrial wood on a national scale.

9.6.10 For achieving the national growth goals, there should be three distinct levels in planning : (a) national plan; (b) regional or State plan; and (c) local plan. Planning could be both from the top at the national level or from the bottom at the local or project level. The national production goals should be split into regional targets and the latter into local targets with a view to producing specified products from specified areas. The core industry and its location should be identified in advance, so that the development of forestry production programme through local or project plans could be planned around such a core industry.

Industry Oriented Management Plans

9.6.11 As far as possible, the area management plan should be replaced by purpose or production or industry oriented project plan. An industry oriented management plan should be designed for the production of fixed quantities of raw materials of the industry or industries with which the plan is linked. Maximum utilisation of the various products and byproducts from the same area or the same tree should be an essential feature of the plan. There may be different area coverages for different types of raw materials, when required by the same industry.

9.6.12 The satisfaction of the bonafide domestic needs of the local community from the operational area itself or from separate areas reserved for the purpose should be a part of the industry oriented management plan. The creation of local employment should be speci-

fically taken care of in the preparation of the plan. The biological requirement of the species occurring, or the species that are proposed to be introduced, should be the primary consideration in the plan formulation. The provision of financial and other inputs, including staff and equipment, should form an integral part of the sanction for the plan by a competent authority. The first phase of the industry oriented management plan should be the optimum utilisation of the existing crop (crop I). The second crop (crop II) need not be a reproduction of the original crop, but should be planned for the actual requirement of the existing and projected industries.

Organisation

9.6.13 The lowest unit from which forestry statistics originate is the forest range. Only a few States have a statistical cell for compilation of data. Statistical organisations should be set up in the State Forest Departments and separate officers and staff provided for maintaining, compiling and reporting data at range, division, circle and State levels. At the Central level, the existing statistical unit in the Central Forestry Commission should be developed into a fullfledged statistical division and put under the charge of a Statistician in the appropriate scale.

9.6.14 A National Forest Information System should also be developed to act as data bank in respect of information required for planning, implementation, evaluation and modification of forestry programmes. For building up an efficient system, the requirements are : (a) national forest inventory, (b) national timber trend studies and (c) data processing. The system, however, should be a part of the activities of the forest inventory organisation and built up in stages.

9.6.15 A pattern should emerge in which the States would be responsible for collection of statistical data sought for by the regional units of the Central forest inventory organisation. The latter would process and analyse the data and maintain the information bank for feeding the States with the necessary data in their planning work. In the States, resources survey and planning organisation should be created.

Forest Research and Education

9.6.16 In the forestry sector research and development could not keep pace with the time and needs due to various constraints—organisational, financial and technical. Considering the urgent necessity for creating a sound research base in the Forest Departments in the States,

the universities, the FRI and its regional research centres at Coimbatore and Bangalore, and for reorienting forest education, measures were recommended in the Interim Report on Forest Research and Education submitted in March, 1974.

9.6.17 The Central Government would be particularly responsible for carrying out industrial research in addition to coordination and collaboration of research on different aspects with universities and the States. Apart from the FRI, which would continue as a 'national institute', the Central Government should set up, where necessary, multidisciplinary regional research institutes and specific problem-oriented research centres. Instances where such centres may be set up are : (a) latosols *vis-a-vis* forest management practices and (b) sandal spike disease. The State Forest Departments should primarily confine themselves to applied research on local problems on forestry, forest biology and forest management, and establish well-staffed and well established research institutes if necessary. Facilities and expertise available in the agricultural and other universities have not been fully utilised to meet the research needs in the States. This lacuna should be made good. The State Forest Departments should provide them with necessary facilities and support.

9.6.18 The agricultural and other universities, which would take up forest research, should, to begin with, include forestry as one of the subjects in the undergraduate courses, the scope being gradually widened to graduate and higher degree courses. The syllabus should be drawn up by a national committee. The FRI should also organise graduate and other higher degree courses in forest science.

9.6.19 For direction and promotion of forest research and education, there should be a Council of Forest Research and Education (CFRE) under the chairmanship of the Union Minister of Agriculture and Irrigation. The CFRE should be assisted by standing committees on various groups of disciplines for carrying out its functions. The management of personnel for research and education should be placed on a proper footing.

9.6.20 Several important topics have been indicated for research on different disciplines. The regional technical committees, to be set up by the CFRE for identification of research problems, should consider, and give due importance to, the topics on research indicated. A unit of industrial design, which should be set up in the FRI to expedite commercial exploitation of proven pilot experiments, should design machinery for developing economic units for industries, particularly for utilisation of logs of smaller girth by the plywood factories and for the establishment of smaller economic pulp and paper mills. A collaboration with the CSIR should be established in utilisation and indus-

trial research.

9.6.21 A revised pattern of in-service education and training has been suggested for the higher forest services, i.e. Indian Forest Service and State Forest Services. For both these Services, the plan of in-service education and training should follow the same principle, but the course content should be carefully drawn up to account for the difference in the levels of responsibility. For the State Forest Services, there should be one or two separate colleges. In the first year, a few basic courses would be compulsory for all recruits. These basic courses should generally be followed by study in the field. The second year would be mainly 'in-residence', except for the students' association with problem-oriented field projects in the last six months as part of their dissertations. The curriculum should be organised into five divisions of instructions, namely management and resource control, inventory and planning, production and resource utilisation, wildlife and environment, and wood science. Of the above five divisions, the division of management and resources control would be compulsory for all, while each student would have also to study subjects included in one of the other four optional divisions. Under this scheme, subsequent specialisation with higher studies in the FRI or in the universities may be relatively easy.

9.6.22 Facilities for periodical training of officers at different levels on the staff college pattern should be created in the FRI. Normally a person being promoted to a higher post or with a different kind of responsibility (e.g. posting in a forest corporation) should undergo the training.

9.6.23 As in the case of higher Services, the in-service education and training for the Forest Rangers should include tours in the field in the first year and 'in-residence' academic instruction in the second year. The training of Deputy Rangers/Foresters and Forest Guards is mainly field-oriented, and each State should devise its own plan of training and update it periodically to suit local conditions.

10

INPUTS

1 SEEDS

10.1.1 Seed multiplication programmes have so far been formulated and implemented with Governmental initiative, efforts and organisation. The question for the future is whether a seed programme to cover the entire area of the country with good quality seed should be developed on commercial lines or on social welfare considerations. The social welfare approach to seed development, with direct governmental involvement would commit the official machinery to an intricate task of a vast magnitude, which is not desirable. The programme should, therefore, be developed on commercial lines so that it generates interest, spirit of competition, a motive for profit and, in the process, employment potential for the educated as well as others.

10.1.2 Besides fulfilling internal needs, the seed business can also be developed so as to cater to the needs of the foreign countries. The variety of agroclimatic conditions in the country confers an advantage of producing seed of crops which thrive in temperate, subtropical and tropical latitudes or which flourish in different ranges of humidity and soil moisture. Reputed foreign seed firms and scientists could be invited to collaborate in the programme of seed production for their countries.

10.1.3 In the Commission's Interim Report on Multiplication and Distribution of Quality Seeds pertaining to High Yielding Varieties and Hybrids of Cereals, the responsibility for seed multiplication at different stages has been specified in order to induct as much of private interest into the business as possible and introduce market intelligence by way of Governmental assessment of seed requirements and laying down of targets of production for individual agencies. The areas of responsibility for the multiplication of breeder, foundation and certified seed and the relative roles of the ICAR, the State Governments and other organisations like the National Seeds Corporation (NSC) in the multiplication and distribution of seed of cereal crops have been laid down in the Report. In particular, it has emphasised the urgency and importance of having a national register of varieties to ensure that the same variety is not given different names by different variety

release committees and that a central place is used for properly maintaining a full description and other particulars relating to the varieties, whether released by the Centre or the State. The Central Seed Committee (CSC), with the assistance of its State subcommittees, can operate a system of national registry by charging a suitable registration fee and also arranging to inspect material on site so as to ensure the distinctiveness of the variety in question. It will be necessary for the CSC to constitute separate subcommittees for dealing with the specialised group of crops. Similarly, the NSC can have specialised wings for such crops in its organisation. It is expected that the CSC, the ICAR and the State Governments will evolve a working machinery to attend to current problems that might crop up in implementing the seed production programme.

Measures to Make Seed Business Attractive

10.1.4 Efficient and quality seed production demands isolation from other cultivated land and large scale plant protection measures. These requirements are fulfilled if the land area used for seed production is large and consolidated. This is the basis of the 'compact area approach' advocated for seed production. In order to make the participation of small farmers possible in the seed programme, it is necessary that they should be organised to pool their land resources into compact and viable units. The certified seed agencies, which have to depend on the resources of the small farmers to a considerable extent, will have to educate and encourage them to join together on a voluntary basis. In this task the State Government will have to extend to the agencies will possible administrative and financial support.

10.1.5 Seed production involves substantial investment, besides being subject to loss because of bad weather and the risk of rejection of seed in the course of certification. In order, therefore, to make seed production attractive to the farmers, there is a legitimate case for compensating the seed growers through seed crop insurance which, if introduced, has the added advantage of enabling commercial banks to finance seed production. The Ministry of Agriculture and Irrigation should take the initiative in finalising a seed crop insurance scheme and giving it a trial before general application. Another measure, which will support seed production, is to exempt certified and treated seed from the levy on foodgrains, and also from octroi, sales tax and other local taxes, which add to the cost of seed and introduce an element of disparity in the sale price of seed from place to place. Besides, detrimental practices like *sawai* system and sale of uncertified substandard seed has to be discouraged and the organised seed agencies should not resort to such practices.

10.1.6 Conditioning of seed for viability and sale is essentially linked with the post-harvest operations of processing, packaging and storage, which need to be developed as an integral part of the seed industry. It will be ideal if all the organised seed agencies whether foundation or certified, and individual seed growers could be encouraged to form limited concerns on a regional basis to own and set up a network of seed processing plants and storages throughout the country. Even packaging can be included in their scope.

10.1.7 Seed processing has to be made compulsory and undertaken separately from the produce of commercial crop. Processing equipment in use in the country are mostly obtained from foreign countries and attempts at manufacturing such machinery within the country have been in the direction of developing only the prototypes. Whatever is being manufactured at present is mostly in the small scale sector, which is faced with problems of inadequate supply of basic raw materials, like steel, and manufactured components, like sealed bearings, processed screens etc. These bottlenecks have to be removed. Indigenous manufacture should replace import substantially. The Industrial Development Centre of the NSC and the Indian Standards Institution should collaborate closely in designing and developing suitable specifications for fabricating processing equipment and machines suited to Indian conditions. In the intervening period, when the country will have to depend on imported machinery, the Centre should liberalise its import policy with regard to the required machinery.

10.1.8 Similarly, in regard to packaging, which comes after processing, the Seed Technology Division of the IARI, the Industrial Development Centre and the Indian Institute of Packaging (Bombay) have to join together in developing methods, materials and designs for ideal packaging suited to different requirements. New innovations like chemical coating of seed, as developed in other countries, for special crops and readymade "seed on tape" have also to receive the constant attention of research in packaging.

10.1.9 The storage life of seed is influenced by a number of factors, of which humidity and temperature are the most important. Fungal and insect activity increases to the detriment of seed quality when relative humidity and temperature of the store are higher than 40 per cent and 20°C respectively. Breeder seed is required to be stored at about 5°C and, if so done, the vitality and vigour can be retained for as long a period as five to six years. Similarly, the temperature requirements for foundation seed vary from 5° to 15°C. Both the breeder and foundation seed, therefore, need airconditioned storages and the storage for certified seed should only be damp proof and free from pest attack.

10.1.10 Seed will have to be transported speedily because of short

duration of sowing operations and any delay in seed movement could make all the difference between the success and failure of the crop. All transport facilities, including movement by air, of seed material, at concessional air freight, will have to be thought of to ensure rapidity of movement. The railways, in particular, have to provide the required number of wagons on time for the purpose.

Measures for Quality Improvement

10.1.11 Since seed is not meant for consumption, the marketing of seed should be exclusively regulated through the provisions of the Seeds Act alone. The Central and State Governments should ensure that seed marketing is enforced only through the Seed Inspectors under the Seed Act, and not through the marketing staff under the provisions of the Agricultural Produce (Grading and Marking) Act or under any other law. Clear orders are necessary to the operational staff to remove any ambiguity which might be existing in this regard. Further, since the Seeds Act is basically regulatory in nature and is meant to ensure that seeds of notified varieties offered for sale conform to certain minimum limits of purity and germination, the enforcement machinery should try to educate dealers and encourage them to maintain proper norms rather than take penal actions.

10.1.12 The Seeds Act has been formulated in the infant stages of the seed industry and many lacunae are being noticed in the course of its enforcement. Many more will come to notice in future. It will, therefore, be advisable to wait for more experience and work through conventions within the framework of the existing law than rush for amendment everytime. In due course, a comprehensive law should be enacted covering all the crops. In the meantime, working arrangements have to be made by the ICAR and CSC with various Directorates of commodity crops as well as Boards of different plantation crops so that common standards can be enforced in all crops on a uniform basis.

10.1.13 Some of the aspects of the Seeds Act require pointed attention. Tests for genetic purity are still uncommon in most seed testing laboratories. Three main tests, viz., laboratory test, greenhouse or growth chamber test and field plot or grow-out test, are generally useful for determination of genetic purity. Apart from genetic purity, grow-out test provides useful information on the level of field emergence which determine vigour and viability. Grow-out test, should, therefore, be made an integral part of seed testing and entrusted to seed testing laboratories. Error in hybrid seed production will not give the desired cross and will nullify the expensive and

laborious efforts made in the evolution of parental lines and in the production, maintenance and stocking of its breeder and foundation seed. Like hybrids, vegetatively propagated crops have also their special problems involving the use of degenerated stock. There is, thus, an obvious need for an impartial check on seed production, without exception, in the case of hybrids and vegetatively propagated crops. Compulsory certification of seed material is, therefore, desirable both of hybrids and vegetatively propagated crops.

10.1.14 Another important aspect vital for the maintenance of the quality seed is the number of generations up to which the seed can be multiplied from the produce of the previous crop without resort to renewal. In order to avoid chances of deterioration in the multiplication of seed at different stages, breeders or breeder institutions should specifically state about the chances of a variety maintaining the veritable standards as needed under certification. The Central Seed Certification Board should specify for each variety the time limit up to which subsequent multiplication can be practised without deterioration of the standards.

Seed Research, Education, Training and Organisation

10.1.15 Seed research, according to modern concept, is fairly new to the country. Particularly, very little information is available on seed contamination and pathology. There is need to undertake research under Indian conditions in almost all the fields of seed production, preservation and standardisation. Seed ecology, biochemistry, physiology, pathology, entomology, breeding and cultivation aspects as also the laboratory or industrial aspects require attention. Physical constants of seed under various conditions and for various purposes also need to be determined. Congenial areas for seed production for every crop will have to be identified and developed through experiments. In this work special emphasis should be given to the selection of areas remote from the traditional areas of cultivation in respect of every crop. Specialised pockets of seed production already exists in the case of vegetable crops, but the material being produced pertains to varieties of unknown purity and performance. In their case, therefore, the need is to educate the traditional growers in the practices of growing quality seed and provide them with the requisite inputs and guidance. Another point for consideration could be whether their own material could not be improved upon rather than introducing new material.

10.1.16 The seed problems of some of the important crops need specific attention. In the case of sugarcane, multiplication of disease free planting material is a prime necessity. It is equally important to

multiply sufficient quantity of seed material suitable for every track. The responsibility for breeder seed should lie with the Central Sugarcane Research Institute, Coimbatore. Increased attention should be given to the research and multiplication aspects of fodder crops so that adequate quantities of good quality seed become available. The State Departments of Agriculture should take direct responsibility in planning and encouraging this work with the help of established foundation and certified seed agencies.

10.1.17 In the case of fruits, vegetables, flowers and plantation crops, the existing varieties should be screened in order to choose the best amongst them and then take measures to multiply the seed material of the selected varieties in adequate quantities. Seed material to fruit growers must pass through known pedigree orchards and, for this, it is very necessary to establish a chain of progeny orchards from breeder to foundation and certified seed stages. The supervision and promotional measures with regard to progeny orchards must be the responsibility of State Governments. Detailed codes are laid down within the purview of Seeds Act to regulate multiplication and distribution of seed and planting material of these crops through progeny orchards. In particular, papaya seed requires to be multiplied under controlled conditions through artificial pollination and bagging of selected types in order to avoid mixing. In the case of banana and pineapple, clones of improved types and known pedigree are required to be multiplied for the sake of uniformity and better production. For guava, the vegetative propagation through experimentally proven methods, such as by airlayering, could be tried for multiplication. The important problems of mango is to standardise the stock and scion. Nucellar technique could be utilised to develop uniform rootstocks. The method of clonal propagation by airlayers could also be tried. Scions require to be multiplied from varieties whose fruiting performance has actually been verified. Once the parent material has been thus established, veneer grafting could be adopted for mass production. Similarly, the nucellar technique could be employed to produce virus-free planting material of citrus, which is its major problem. Vegetative propagation through budding and airlayering could be tried for cashewnut multiplication. In the case of cardamom, the possibility of grading rhizomes for multiplication purposes in the aphid-free period is worth trying in the same way as applicable to potato.

10.1.18 Since seed research covers a very vast field, the ICAR should make thorough appraisal of the general as well as cropwise problems and organise an integrated programme of research. Arrangements should also be made for the introduction of suitable courses in seed production methods, seed physiology and health and seed tech-

nology, testing and certification in all agricultural universities both at the graduate as well as postgraduate levels. Some suitable courses in the management aspects of seed business could also be introduced in the existing Indian Institutes of Management as an interim measure until a separate specialised management institute with bias towards agriculture, animal husbandry and rural sciences is established. In addition, short term training courses have to be introduced by State Departments of Agriculture for training the lower cadres as well as private seed producers, processors, salesmen etc.

10.1.19 Seed production and distribution should be preponderently private and the involvement of Government confined only to overall supervisory, advisory and fostering activities. In the Governmental setup, seed production, seed law enforcement and seed certification should be independent of each other. Departments of Agriculture at the Centre and in the States should have three distinct wings, each dealing with the input aspect, law enforcement and certification. Insofaras certification is concerned, the Central Seeds Certification Board, together with its State Boards, could serve the purpose of the third wing. To organise the seed industry in an effective manner, the NSC should have a separate new wing to look after the promotional activities like the establishment of new seed enterprises, training of personnel, and rendering technical advice to banks and other leading agencies on credit and financial needs of the seed industry.

2 FERTILISERS AND MANURES

Role of Fertilisers in Crop Production

10.2.1 Addition of plant nutrients in the form of fertilisers constitutes an essential step in agricultural production. The increasing needs of agricultural produce in the coming years in India will be met more by increasing the per unit area productivity than by bringing new lands under cultivation, the scope for which is extremely limited. Appreciable increase in production per unit area has become possible by taking recourse to multiple cropping programmes, utilising high yielding varieties of crops and necessary inputs including fertilisers. Experiments have shown economic returns even under rainfed conditions, provided the choice of varieties and quantity, method and time of application of fertilisers are made judiciously.

Plant Nutrients

10.2.2 Soils get depleted of nutrients by raising crops. The
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amounts of nutrients removed by crops vary widely depending on different factors. In comparison to what are added in the form of fertilisers, the quantities of nutrients removed by crops are staggering. This underscores the need to put in the best efforts at recycling resources and returning wastes to the field. Studies have established that a low but stable level of fertility is maintained as a result of large increments of nitrogen, which accrue from natural recuperation processes in the soil. In India green manuring with leguminous crops has been practised from olden days and constitutes an important feature in crop rotation and mixed cropping. Various estimates have been made as to the amount of nitrogen added to the soil due to the symbiotic processes in root-nodules of leguminous plants. More recent studies have revealed the usefulness of inoculation of a number of leguminous crops grown in India by certain strains of rhizobium. A number of free living organism inhabiting the soil are capable of fixing nonsymbiotically, atmospheric nitrogen. Apart from nitrogen, these bacteria are known to release growth promoting substances which enhance seed germination and ensure better and more vigorous stand of plants, thereby indirectly increasing the yield. There is considerable scope for finding newer and more efficient organisms capable of nitrogen fixation.

10.2.3 The monsoonic climate in India keeps extensive areas in various parts of the country in waterlogged conditions, where rice is grown year after year without any significant decrease in yield. The main biological consequence of waterlogging, as in rice fields, is the growth of several forms of algae. Some of these, especially the blue-green algae, are known to fix atmospheric nitrogen. Blue-green algae have added advantages as they can solubilise slightly soluble phosphates in soil and supply growth promoting substances. The yield increase by algal fertilisation is observed even in the case of high yielding varieties of paddy, which are highly nitrogen responsive and usually heavily fertilised with nitrogen. When superimposed on added nitrogenous fertilisers, the differential increase due to algal fertiliser is much greater than nitrogen fertilisers alone and more profitable. Algal fertilisers, therefore, deserve to be exploited to the fullest extent.

10.2.4 The high yielding varieties have exacting nutrient requirements, which soil reserve and natural recuperative processes can hardly cope with. For success in modernised farming, an efficient and balanced use of fertilisers and manures is imperative. Whatever may be the soilwater complex, there should be a well planned cropping system providing nutrients for growing crops, in sequence or rotation, in order to build up soil to a high state of productivity. For soil affected with acidity, salinity and alkalinity reclaimatory measures are required to be

followed by growing crops with adequate fertilisation.

10.2.5 As a result of experimental findings and demonstrations, there is a strong awareness of the balance that ought to prevail in respect of the major plant nutrients, N, P and K. A correct measure of nutrient balance should be based on the ratio in which they appear in fertiliser recommendations resulting from field trials instead of the ratio of consumption, as is usually done. If recommended doses could be uniformly followed throughout the country, the consumption ratios would have compared favourably with those of the developed countries. In fact, the departure from the recommended doses is most often caused, among other factors, by nonavailability of fertilisers and not necessarily due to lack of awareness of the usefulness of balance in fertilisation.

Assessment of Fertiliser Requirement

10.2.6 In planning agricultural production, the assessment of fertiliser requirement is crucial. For the assessment of fertiliser requirement for future years, three methods have been applied. They are based on : (a) replenishment of nutrients removed by crops; (b) areas under crops and recommended doses; and (c) demand for agricultural production and response rate of crops to addition of fertilisers. Of the three methods, the one based on replenishment of nutrients removed by crops would appear to be straight forward. The data on nutrient removal by foodgrain and nonfoodgrain crops when compared with the nutrient consumption during past few years, indicate certain relationship. Thus, if the demand for N, P_2O_5 and K_2O is set at 60, 50 and 10 per cent respectively of the total quantities of each removed by the harvested plant products, the nutrient removal of foodgrain crops for 1980-81 would be 12.5 million tonnes comprising 4.17, 1.64 and 6.69 million tonnes of N, P_2O_5 , and K_2O respectively. Thus the demand for 1980-81 may be set at 2.50 million tonne N, 0.82 million tonnes P_2O_5 and 0.67 million tonnes K_2O , which add to 3.99 million tonnes, close to one-third of the total. By using the same yardsticks the combined fertiliser requirement of the foodgrain and nonfoodgrain crops for 1980-81, in terms of N, P_2O_5 and K_2O come to 3.41, 1.27 and 0.99 million tonnes, which total 5.67 million tonnes, close to one-third of the total nutrients (18.12 million tonnes). On the basis of the same norms, the quantity of fertilisers that will be required for achieving the targeted production of foodgrains and nonfoodgrains during 1985 works out to 3.6, 1.3 and 1.1 million tonnes of N, P_2O_5 and K_2O respectively, totalling 6.0 million tonnes. Assuming that the consumption of fertilisers will follow the earlier trends, the require-

ments of N, P₂C₃, and K₂C will be 3.6, 1.4 and 1.0 million tonnes respectively, totalling 6 million tonnes. This is the same as calculated from nutrients removal method.

10.2.7 Under the second method based on area under crops and certain assumptions with regard to the recommended doses, fertiliser requirements for 1978-79 work out to 8.5 million tonnes (N 5.21, P₂O₅ 2.19 and K₂O 1.10 million tonnes) for foodgrain and non-foodgrain crops. If the trend of consumption during 1967-68 to 1973-74 is maintained, the extrapolated estimates for 1978-79 will be 4.24 million tonnes (N+P₂O₅+K₂O), giving a consumption of nearly half of the estimated requirement of each. If, however, the demand is set at 60 per cent N and 50 per cent P₂O₅ and 60 per cent K₂O, the total quantity will come to 4.89 million tonnes (N+P₂O₅+K₂O) i.e. 57.5 per cent of the estimated quantity. Under the third method, i.e., calculations based on agricultural production demand and the general response rate of crops, taking 1973-74 as the base, the total requirements of fertilisers for the targeted production of foodgrains in 1978-79 would be 4.84 millions. Surprisingly enough all the three methods have given rise to almost similar values.

10.2.8 For making assessment of fertiliser requirement for achieving certain levels of agricultural production the exercise should be more realistic and related to the actual performance in the field. The only merit of the fertiliser assessments made above appears to be that the estimates were checked with actual consumption trend. The percentages of the values calculated on the basis of the three parameters indicated above might otherwise seem arbitrary. The consumption showed an upward trend following the introduction of high yielding varieties of crops. The same increasing consumption trend was made the basis for the future estimates. A further increase in consumption trend will no doubt mark the achievement of a breakthrough in rice varieties, or in bajra and jowar. Any future estimates will have to take cognisance of such possibilities, but in the absence of a definite knowledge of the take off point, there is no other alternative than accepting the present trend of consumption of fertilisers. No separate consideration could also be taken of such parameters of production as irrigation, improved water use, pesticides, seed quality, land shaping, soil and moisture conservation, soil testing, cropping pattern and efficient farm management. Each of these influences the dosage and effectiveness of fertilisers. The dosage of fertilisers is further dependent very largely on their price and availability. On a microscale, an accurate estimate of fertiliser need of a soil region under a particular cropping pattern can and should be made to attain a desired degree of accuracy. But on a national scale, the task of calculation will be

stupendous, even if the necessary information is available. Whether such an exercise would be worthwhile is, therefore, doubtful. There lies the usefulness of the estimates made above on simpler considerations, which are a few percentages higher than the present consumption trend but not too ambitious and unrealistic.

10.2.9 There is a correlation between production of foodgrains and nonfoodgrain crops and consumption of fertilisers. In fact, an increasing trend in fertiliser consumption has been noticed as the agricultural production has increased. Where cultivation is rainfed, water availability is the most important factor but it cannot be controlled. As a result, there are years of good production without commensurate consumption of fertilisers and years of low production even though fertiliser consumption is high. In spite of such uncertainties, there has been an unmistakable rise in fertiliser consumption over the years. The rate of increase was slow during the years 1951-52 to 1964-65 covering the First, Second and nearly half of the Third Plan periods. The rate thereafter became faster coinciding with the introduction of the high yielding varieties. The steady trend is indicative of an awareness on the part of the producers of fertiliser use. An accelerated trend will be expected when a breakthrough, similar to wheat, occurs in other crops, e.g., rice or millets, or else, when a very large coverage under the existing high yielding varieties is achieved as a result of increased irrigation facilities.

10.2.10 A study of the districtwise growth of fertiliser use in India, sponsored by the Commission, has shown that bulk of the past growth in fertiliser use has been concentrated in a small percentage of districts. Thus, in 1968-69, less than 15 per cent of the districts (out of a total of 286 districts) account for 60 per cent of the total fertiliser use in the country, while more than 50 per cent account for only 10 per cent of the fertilisers consumed during the year. Less than one-third of the districts account for 70-80 per cent of the fertiliser use during 1960-61 to 1968-69. Analysis shows further that the growth rate of fertiliser use varies among the districts mainly because of differences in the levels of irrigation, cropping pattern and diffusion of high yielding varieties in the different States. Most of the districts with high growth rate of fertiliser use are those with high levels of irrigation and *vice-versa*. There are some districts which have shown good growth rate in fertiliser use primarily due to the cultivation of commercial crops such as cotton, groundnut and tobacco in the cropping patterns of such districts. The impact of high yielding varieties on growth in fertiliser use has been mainly confined to districts with moderate to high levels of irrigation.

10.2.11 In the Commission's Interim Report on Fertiliser Distri-

bution, it was brought out that there were certain deficiencies in the action programme for promoting fertiliser use, which had resulted, among other factors, in the slowing down of the rate of the growth of fertiliser use during 1969-70 and 1970-71. The Commission advocated fertiliser promotion measures both by the producers and the Governmental agencies.

10.2.12 There was slowing down in the rate of growth in the consumption of fertilisers from 1971-72 onwards tending to be static, which may be ascribed to the inadequate availability of fertilisers. The hike in the prices of petroleum products has resulted in very high cost of fertilisers and also uncertain conditions of availability in the world market. Supplementation of demand over the indigenous availability by imports will be precarious in this context. The world shortage of fertilisers has to be accepted as a reality for years to come and has to be faced. In view of the uncertain situation and constraint imposed, the promotional infrastructure of the various agencies involved has got to reorient its activities in demonstrating more economic and efficient use of fertilisers. It has been definitely established that it is economical per unit of fertiliser to use the optimum rather than the maximising dose, because of the application of law of diminishing returns which holds good equally for high yielding varieties. A comparative analysis of the fertiliser experiments carried out, using departmental recommendations aimed at maximising production and those using optimum doses, shows that the latter allows a more rational application of fertilisers amongst crops and regions, thereby enabling not only to cover a larger area but also to increase production. The former, however, leads to a high production but necessarily of a particular crop, acting as a hindrance, so to say, to diversification of agriculture and dispersal of benefits. If the extensive use of fertiliser is resorted to, there is possibility of overall increase in production of other agricultural commodities, including foodgrains. This would help in narrowing the gap and disparity in the economic condition of rural farming community and ensure social justice.

Factors Affecting Efficient Use of Fertilisers

10.2.13 The physical, chemical and biological reactions between the soils and added fertilisers determine the availability of nutrients and hence the efficiency of fertiliser use. The nutrient elements of a fertiliser are required to exist in the soil in readily available forms, but their degree of availability is determined by the prevalent soil conditions and the form in which fertiliser is applied. The characteristic of the soil and its environment, and that of nutrient elements, therefore,

determine the overall efficiency of a fertiliser. In the case of nitrogenous fertilisers, the nitrate form of nitrogen is directly available to plants and, if not absorbed as fast as it is formed, is lost by leaching. The possibility and extent of loss of nitrogen through leaching, however, depends very much upon the drainage conditions and type of soil. On the other hand, under waterlogged conditions of rice culture, the ammonical form of nitrogen is usually more suited.

10.2.14 In view of the high cost of fertilisers, attempts are being made throughout the world to reduce their cost of production and application and, at the same time, to increase their efficiency. In this context, the use of anhydrous ammonia has been recommended based on experiences gained in foreign countries. Experiments carried out in Karnataka and Maharashtra by applying anhydrous ammonia to paddy and sugarcane crops shows that it is as good as, if not better than ammonium sulphate or urea. Ammonia used with irrigation water has also been found to be comparable with ammonium sulphate in the case of paddy but is slightly inferior for wheat. Additionally, ammonia reduces harmful nematode population, especially in ratoon cultivation of sugarcane. If adequate safety measures are taken, anhydrous ammonia should, under suitable circumstances, replace the solid nitrogenous fertilisers in the country. Before venturing on its large scale application, which involves new technologies and techniques both in the field and in handling from the factory to the distribution end, a series of experiments need to be undertaken. Because of the risks involved in the handling of anhydrous ammonia, its use can be promoted only through well organised custom services.

10.2.15 A related area of interest is in developing a nitrogenous fertiliser that would generally release its nitrogen through the growing season or preferably over a long period. Such a fertiliser should result in increased efficiency of uptake by plants, minimise gaseous and leaching losses and reduce application costs. Considerable research is underway to coat fertiliser granules in a suitable manure so as to endow them with slow release property.

10.2.16 In the case of phosphatic fertilisers, experiments in India have shown that the application of phosphates with organic manures is beneficial in the sense that crop response to phosphorus is high and fixation of phosphorus by soils is minimised. A better utilisation of phosphate in acid soils, when mixed with farmyard manures, has also been reported. Rock phosphates are the basic materials for the manufacture of practically all the water soluble and citrate soluble phosphatic fertilisers. Basic slag, although low in phosphorus, is one of its important and easily available sources. It is applied directly to acidic soils supplying both lime and phosphorus. The nitrophosphates,

having partly water soluble and partly citrate soluble phosphates, perform very well under acidic conditions and are suitable for application under varied agroclimatic conditions. High analysis ammonium phosphates have several marked advantages as fertiliser materials. They are entirely water soluble and can be applied directly or mixed with other fertilisers and have good physical properties. There are other high analysis phosphates like polyphosphate which promise certain advantages and, therefore, require urgent attention as to their performance under different soil and climatic conditions.

10.2.17 The problem of potassium fixation in soils is not acute as it is with phosphorus. The timing of potassium application is important where large additions are required for economic crop yields. Large amounts are often needed in highly weathered and light textured soils, and in regions of high rainfall.

10.2.18 Micronutrient deficiency in crops is remedied as a routine either by soil application or foliar spray. The awareness of micronutrient deficiency has recently increased as a result of the spectacular yield increase of high yielding variety of wheat and paddy by the application of zinc. With further growth of intensive cultivation constant watch should be kept on micronutrient deficiency and finding suitable methods of incorporating them.

10.2.19 Nutrients supplied at the time of demand by plants are most efficiently used. The task is, therefore, to make the nutrients available to plants during those periods. Methods of application of fertilisers and their efficient utilisation have to be considered in relation to the root systems of crops and their pattern of development in the soil medium. Sufficient information on these aspects is wanting. To tackle this problem requires, among other facilities, an extensive use of radiotracer techniques.

10.2.20 Another operation which deserves particular mention is the application of fertilisers as foliar spray. Considerable controversy exists in regard to the efficacy of foliar fertilisation with urea and also its economics. As leaf characteristics have a definite role to play in the absorption of nutrients, the physiological behaviour of the plant leaves needs to be studied before coming to a definite conclusion about the efficiency of foliar fertilisation with urea or such other fertilisers.

Soil Organic Matter and Organic Manures

10.2.21 The performance of chemical fertilisers in the soil is not fully realised in the absence of an adequate amount of organic matter. The organic matter content of most Indian soils is very low and non-application of organic manure in the face of continuous application of

chemical fertilisers would fail to build up good soil physical properties and reduce efficiency of fertilisers. In fact, better yields could be obtained by using chemical fertilisers in humus-rich soils. Unless, therefore, methods are found to increase the humus contents in soils, the full benefits of chemical fertilisers cannot be realised.

10.2.22 Bulk and consequent cost of transport are handicaps in the application of processed organic wastes to the field. Suitable methods of reducing bulk by chemical, microbiological or other treatments need to be evolved, or else, small manufacturing concerns dealing with waste utilisation may be located as close to the place of application as possible. Enrichment of organic wastes with nitrogen and phosphate will considerably enhance their manurial value. The programmes of development of organic manures by the Ministry of Agriculture and Irrigation, through development of rural and urban composts, sewage and sullage, etc. are attempts in the right direction. The manner in which the urban wastes are processed determines its manurial value, which can be enhanced by suitably treating them with ammonia and phosphatic compounds and which is not being done at present. In developed countries, deliberate attention is being paid to recycle urban wastes for the purpose of converting them, largely by mechanical methods into suitable forms for soil use as sources of plant nutrients. Similar possibilities exists in India. In view of the importance and difficulty of building up the organic matter status of tropical soils, the recycling of processed wastes in all available forms is a matter of urgent necessity. Centres for utilisation of sewage and sullage should, therefore, be multiplied and developed as a continuing feature of the country's development plants.

10.2.23 Rural compost offers a gigantic potential of organic manure and plant nutrient resources. At present, the loss of manurial value caused by the use of dung as fuel is enormous. By introducing gobar gas plants the energy requirements of the farmers household can be met, retaining the munurial value of the dung. The rural population should, therefore, be given adequate technical guidance in making use of this innovation. The importance of organic manure and organic matter lies not so much in supplying plant nutrients as in permanently improving the physical and biological condition of the soil. The application of organic matter and wastes ensures to some extent the much desirable recycling of limited natural resources.

Chemical Fertilisers and Soil Amendments

10.2.24 As the present production technology is mainly dependent on progressive larger use of fertilisers, the gap between the

availability and demand is going to widen from year to year. It will become necessary to resort imports unless the fertiliser production in the country is substantially stepped up. In a vital sector like fertilisers, the shortfall in production is of disastrous consequences. All available resources should therefore, be mobilised to reduce a big shortfall, particularly, in a field where the country's technological capacity is of no mean order. Fertiliser production is handicapped not only by paucity of raw materials but also by the inefficiency of man and materials. The latter are remediable deficiencies. In regard to the raw materials, cost and technological problems stand in the way but are not insurmountable. Of the important feedstocks which are economically feasible and whose technologies are well known, natural gas, naphtha and fuel oil stand out prominently. But their indigenous supply being limited, dependence on import has created problems as a result of the oil price rise. In this context, coal as feedstock has certain advantages. The question of economics has to be weighed in its totality, in which indigenous availability of coal and returns in terms of employment in related sectors of mining and accessory industries have to be taken into consideration. For a long term plan of developing nitrogenous fertiliser capacity, there is no alternative to indigenous production.

10.2.25 The problem in respect of phosphatic and potassic fertilisers appear to be far more difficult because of the inadequacy of indigenous raw materials. For phosphatic fertilisers the two important raw materials are rock phosphate and sulphur. The discovery of considerable phosphate rock deposits in Rajasthan, and in smaller quantities in Andhra Pradesh and Bihar, is recent. They are, no doubt, immediately usable provided the position of sulphur is assured. There is no proven deposit of sulphur in the country. The international sulphur market has fluctuated widely during recent years and there has been crisis in its supply position. It will be, therefore, prudent to avoid sulphur in the indigenous manufacture of phosphatic fertilisers. Meanwhile, geological explorations should be intensified on an extensive scale in search of new sources of phosphorus. In view of the controversy over the ratio of water soluble to citrate soluble forms of phosphate it would be necessary to have an extensive programme of field experimentation for verification of the efficiency of the above two forms of phosphates and their optimum ratio in crop production under varied soil and climatic conditions. In any case, if the difference in crop response between the water soluble and citrate soluble phosphate is not wide, it would be advisable to depend on indigenous raw material in order to sustain production and save scarce foreign exchange on imported sulphur.

10.2.26 With regard to potash, the possibility of utilising by-products of salt industry should be explored and chemical processes developed to make potassium from potash feldspar and mica available for fertilisation. Unlike the nitrogenous fertilisers, phosphate and potash are not subject to loss of leaching and all the phosphate and bulk of potash are present in soil either in an unavailable form or in deeper layers beyond the reach of plant roots. Consequently, some kind of recycling process may be exploited to make the locked up phosphate and potash in the soil, both native as well as from added fertiliser sources, available to crops.

10.2.27 Fertilisers are usually evaluated on the basis of the quantity of the plant nutrients contained in them and the forms in which they are present. The Fertiliser (Control) Order (FCO), 1957, includes prescribed methods of analysis of N, P and K in fertilisers. It is necessary that these methods are updated and revised in the light of newer and more accurate methods of analysis available. The revision is all the more necessary in view of the introduction of new high analysis fertilisers and various formulations of complex and mixed fertilisers. A Committee of analytical and agricultural chemists drawn from IARI, agricultural universities, State Departments of Agriculture and fertiliser industry should go into the various details in respect of all fertilisers to suggest suitable methods of analysis for general acceptance throughout the country. This committee will also review the methods at intervals as new knowledge becomes available. With developing awareness, the preference of the farmers will be directed towards more efficient and, at the same time, less costly fertiliser materials. The fertiliser industry should aim at developing technology for meeting requirements of high analysis fertilisers, straight and complex/compound, so that materials of higher efficiency are made available to the farmers at a low cost.

10.2.28 With a view to increasing the efficiency of fertiliser use and promoting balanced utilisation of nutrient elements by crops, there is a recent shift towards manufacture of complex/compound and mixed fertiliser. These materials are shown by grade designation suggesting the percentage contents of N, P_2O_5 (Available) and K_2O (water soluble). The suitability of different grades has to be related to the particular crop and fertility status of the soils. The extension agency has a responsible part to play in guiding the farmers in the use of the available grades and supplemented by straight fertilisers, whenever necessary. Soil testing data and fertility index maps should help in channelising the fertiliser distribution so that appropriate grades are available to the farmers in relation to their soils and crops.

10.2.29 In the Interim Report on Fertiliser Distribution, the

quality aspect of fertilisers has been dealt with at considerable length and several recommendations have been made to improve their quality. These relate to storage, laying down of standards, expansion of laboratory facilities and strengthening of organisation for quality control, simplification of procedures, development of rapid analysis and legislation. These recommendations are reiterated.

10.2.30 The mixed fertilisers have not found much favour with the farmers as the diminishing trends in their production and distribution show. Whatever few advantages mixed fertilisers have they are outweighed by many disadvantages and as such there is no point in encouraging their manufacture. Single or complex fertilisers are available in granular forms which can easily be mixed according to needs and applied.

10.2.31 The benefits of liming acid soils insofar as agricultural production is concerned are well appreciated and extensive data are available with regard to the degree of liming in varied soil conditions for optimum results. Basic slag as a liming material and as a fertiliser obtained from Indian steel industry has not been put to agricultural use due to poor quality and difficulty in grinding the hard slag to specified size, although several million tonnes have accumulated over the years creating problems of disposal. An evaluation at the IARI of indigenous basic slag for crop production indicates that P_2O_5 available per year from this source is around 54,000 tonnes. Apart from P_2O_5 it will supply equivalent of 1.4 million tonnes of calcium carbonate. In addition, basic slag is well supplied with secondary and minor elements. The application of basic slag of 80 kg P_2O_5 /ha corresponds to an addition of 1,200 kg CaO/ha and thereby reduces the lime requirements of acid soil to about one-third of its original value. In view of the dual benefits derived from application of basic slag, it will be economical to process the material for agricultural use. The benefits of basic slag in acidic soils should be demonstrated and grinding facilities developed under the auspices of iron and steel manufacturing agencies for making use of this valuable waste material for agricultural production.

Fertiliser Dose

10.2.32 At present, generalised fertiliser recommendations have been drawn up by the States for various crops in different administrative units of agroclimatic regions. In actual practice, however, the doses applied by farmers rarely approach the recommended levels. The reasons for this should be investigated in order to take remedial measures. Two economic situations are recognised in farming, namely,

one in which maximum profit per hectare is derived from fertilisation and another in which maximum return is obtained per rupee invested in fertilisers. The fertiliser trials should be so designed as to enable isolation of these two situations and to make separate recommendations for each.

10.2.33 The generalised recommendation of fertiliser doses for various crops would be more useful for programming fertiliser despatch to potential areas of consumption. For a more accurate scheduling of doses from one field to the other in an agroclimatic region, soil tests backed by research experience on crop response should be a better guide. Soils in the dry farming areas are generally low in nutrients. In fact, even the meagre moisture supply through rainfall could be profitably and efficiently used for crop production, if imbalances in nutrient status of these soils are corrected through judicious fertiliser use. In dry farming areas, therefore, balanced and judicious fertiliser use is called for in order to utilise efficiently available soil moisture. In view of the fact that farmers have become conscious of fertiliser use and do not hesitate in making investment in fertilisers in the expectation of a reasonable return, it is necessary that all co-ordinated research programmes and projects should lay considerable emphasis on the economics of fertiliser use not only with reference to a particular soil type and single crop but also to the sequence of crops in multiple crop fertilisation. This concept, when taken to its logical conclusion, would not only increase the efficiency of fertiliser use but also entail considerable economy.

Soil Testing as a Guide to Efficient Use of Fertilisers

10.2.34 The generalised fertiliser recommendations at present being made are useful for the purpose of guiding the farmers in the use of fertilisers but they lack in relevance to the prevailing fertility conditions of the farmers' fields. Soil testing is an essential element in the evaluation of the nutrient status of soil. The data derived on the available contents of nutrients in soils are useful in recommending economic and efficient use of fertilisers. The efficiency of soil testing should be improved, so that the predictability of crop response to fertiliser use based on soil tests is enhanced. While recommending fertiliser doses, it should be ensured that they are appropriate for the soil to be used, the crop to be grown and the level of farm management. Steps should, however, be taken to improve the working efficiency of soil testing laboratories by keeping the measuring instruments in order and introducing automatic and time-saving devices. It is also necessary to involve the farmers in the soil test servicing programme in order to

create interest in them and motivate them in getting their soils tested for better fertiliser use.

10.2.35 In each State there should be a central laboratory to function as a control laboratory. There should be an officer of high rank at the State headquarters to coordinate the work of the different laboratories and to render necessary help for the efficient working of the laboratories. The State Departments of Agriculture should continually evaluate the performance of the mobile soil testing laboratories. They should have a close look into the working of the laboratories set up by the fertiliser manufacturers, marketing federations and other private agencies so that the developed facilities are not utilised to the detriment of balanced use of fertilisers. The institutional and private soil testing laboratories should demarcate the areas of operation in order to avoid unnecessary overlapping. Before additional soil testing laboratories are established, the existing facilities should be fully utilised and the quality of services improved.

10.2.36 At present a large number of fertiliser demonstrations and trials are being conducted by different agencies. It is necessary to coordinate such demonstration trial so that they are widely spread out. For this purpose, a coordination Committee under the Chairmanship of the Director of Agriculture may be formed in each State in which all the participating agencies should be represented. This committee will draw up an annual programme, specifying the area of operation for the different agencies, ensure fertiliser use based on soil tests and evaluate the effectiveness of the programme.

10.2.37 A scheme of soil test-crop response correlation has been in operation for quite sometime and considerable data have accumulated for a number of agroclimatic and soil regions. The data should be analysed to draw fertiliser schedules. Soil test-crop correlation studies should be continued in order to guide the soil testing laboratories in formulating more and more reliable and reasonable fertiliser use recommendations. The officials of the soil testing laboratories should be adequately trained in various aspects of soil testing including interpretation of data so that they are able to make specific fertiliser use recommendations for different crops and soils. There should be a programme of revision of fertiliser schedule as new knowledge develops. A rapid method for correlation of soil test analysis with crop response data has been developed under the International Soil Testing Project of the North Carolina University. It is worthwhile giving a fair trial to this method so that specific fertiliser use recommendations could be worked out without much loss of time.

10.2.38 At present the soil fertility maps are being prepared on the basis of the district which is an administrative unit. For proper

assessment of the fertiliser needs of each administrative unit and efficient fertiliser distribution, soil fertility maps prepared by adopting improved methodology should be superimposed on administrative unit maps.

3 PLANT PROTECTION CHEMICALS

10.3.1 Insects, pathogens, weeds, rodents etc. throw a stiff challenge to man in his efforts towards increasing agricultural production. The insecticidal property of DDT, a chlorinated hydrocarbon, revolutionised pest control, especially the insect pests, which further laid the path for the appearance in quick succession of other chemicals, e.g., organophosphorus and carbamates. A highly prospective industry has now been established which has provided an effective arsenal for the control of pests not only to enhance production but also to prevent wastage in stored condition. Because of the diversity of pests affecting the crops, the chemicals had to be specific and selective in their action, and, therefore, insecticides, fungicides, rodenticides, weedicides, nematicides, acaricides, molluscicides, etc. have been developed according to the nature of pests.

Role of Chemicals in Pest Control for Enhanced Crop Production

10.3.2 The new cropping patterns and the luxuriant growth of plants induced by the use of fertilisers and irrigation have created tremendous pest and disease problems. The control of pests enables a crop to yield its maximum within the limitations of its environment. In the absence of such a control, the degree of damage inflicted on the crop determines the quantum of its yield, which may vary from poor harvest to none at all. Because chemicals have proved most effective against pests, they have received by far the greatest attention.

10.3.3. The use of recommended dosages of plant protection chemicals enhances crop production. Unlike fertilisers, pesticides do not increase yield but only control the losses. Fertilisers used in amounts less than the recommended doses yield less, but in the case of pesticides, a smaller dose than that recommended may not only yield less but also encourage resistant varieties of pests. Hence, plant protection schedules should be followed scrupulously to avert such a contingency.

10.3.4 Other chemicals which have been tried on a small scale to control insects are the chemosterilants, sex attractants and juvenile hormones. Most of these chemicals are, however, very unstable and hence cannot be relied upon. Synthesis of more stable analogues is being attempted. Being biodegradable, toxicity problems do not arise

with juvenile hormones. Even though costly, interest in these substances is growing because they seem to have the answer for pollution caused by the use of the common protection chemicals.

Extent of Crop Loss due to Insect Pests and Diseases

10.3.5 That considerable loss in yield of crops occurs due to ravages of pests in the field is universally acknowledged. There has, however, been hardly any consistent and systematic effort to work out losses of crops due to pests on scientific lines on an all India basis. In the absence of any reliable estimate, various 'guesses' based on individual and official impressions have been in vogue. One of the most commonly repeated official guesses is that losses to crops due to ravages of insect pests, diseases and weeds amount to about 20 per cent, the monetary value being over Rs 1,000 crores every year, most likely in respect of food crops only. The guesses ventured by individual scientists based on limited information may be considered as 'felt loss'. These guesses vary widely and hence, no definite percentage loss can be fixed. Some estimates of loss estimation due to diseases, insect pests, nematodes, weeds and rats respectively based on small scale experiments have been made in the country, but these have limited applicability and hardly represent the actual situation in the field.

10.3.6 In the survey conducted by the Programme Evaluation Organisation (PEO), on the High Yielding Varieties Programme during *kharif* of 1967 and 1968 and *rabi* of 1967-68 and 1968-69 yield data were collected from the sampled participant cultivators by interview method and hence these estimates of loss have limitations even though analysed statistically. Results on loss estimates made by the Institute of Agricultural Research Statistics (IARS), in collaboration with the Central Rice Research Institute, Cuttack, and Tamil Nadu and Andhra Pradesh State Departments of Agriculture show considerable variations in losses from crop to crop and State to State. Amongst the States, Andhra Pradesh has worked out losses assuming 20 per cent as loss for all the crops in general whereas Karnataka has based loss figures on general estimation for each crop and indicated them as percentage of yield per hectare, the losses varying from 2 to 35 per cent for different crops and seasons.

10.3.7 Sound methods for the accurate estimation of losses are essential, so that long term research programme aimed at preventing losses could be formulated and launched. It is sometimes necessary and possible to estimate the 'critical' or 'threshold' or often called 'economic threshold' level of intensity of attack, beyond which it would be uneconomic to take any control measures. Studies conducted in

India do not give any indication of the more important criterion, namely, the 'economic threshold'. I must not be assumed that a certain level of intensity of a pest and of the resulting damage would always cause the same yield loss, or that smaller and greater intensities would necessarily cause proportionate lower and higher crop losses. Environmental, varietal and many other local factors may profoundly affect such relationships. The need for a study of these factors in different localities and under different conditions cannot be over-emphasised. Most of the crops are, for instance, able to recoup from injuries by pest attack incurred early in their growth or away from the critical stage. Such a critical stage for each variety of crop should, therefore, be ascertained by careful experimentation.

10.3.8 The IARS should examine the available data on various coordinated trials carried out all over India to arrive at an estimate of crop losses by insect pests and diseases. The Institute may design experiments to enable valid estimates to be made of crop losses by insect pests and diseases.

10.3.9 Some of the chemicals and/or their solvents and carriers may affect yield responses independent of the chemicals. Their effects, if any, on crop response have to be taken into consideration. So far losses have been expressed either in percentage or in quantity or in monetary value. Crop loss estimates should preferably be expressed on a uniform basis.

10.3.10 The nature of research work and field study, the methodology to be followed and the organisation necessary to estimate crop loss are indicated below :

- (i) Research work and field study : Epidemiological studies on various pests, ecological studies on population dynamics, determination of economic threshold, off-season biology, host-parasite relationship, critical growth stages of various crops etc. are some of the items of research work. For the purpose of verification, these studies have to be continued at least for 3-5 years under different agro-climatic regions and pests situations. Wherever possible, laboratory work and field testing may run simultaneously to gain time.
- (ii) Methods : The methods to be followed in crop loss estimation have to evolve from research and field study, as stated above, together with a review of methodology practised elsewhere. The Food and Agricultural Organisation (FAO) of the United Nations Manual (1971) on Crop Loss Assessment Methods is of great value. Neither pest populations nor crop losses are static but they change

from year to year in a given location. Experiments should be conducted for at least three years at each of a number of locations. Such information needs to be updated every 5 years. The need would be greater in future because of rapidly changing cultural practices, and introduction of new plant varieties and agricultural chemicals. Future work should pay attention to the determination of pest combinations in different regions.

- (iii) Agencies : Keeping in view the pest problems of various crops in different regions and situations, ICAR may, without allowing duplication of work, sponsor problem oriented well defined research projects in research institutions and agricultural universities. A close liaison with State Departments of Agriculture would be highly desirable. It may be appropriate to have the cooperation of the pesticides industry at a consultative level.

10.3.11 Each crop is affected by various insect pests and diseases in different States. Insect pests and diseases reported by the States are fewer and almost all of them are considered serious. In fact, moderate insect pests and diseases are usually ignored for the purpose of reporting. Literature on insect pests and diseases is more extensive and lists a much greater number of them than are reported by the States. Attention is drawn to the moderate insect pests and diseases which are potentially serious, and have to be reckoned with in future.

Efficiency of Chemicals in Pest Control and Increasing Crop Production

10.3.12 Experiments on the efficiency of chemicals in controlling pests of crops have been conducted in the country by individual workers and under coordinated projects. Yield increase to varying degrees by the use of chemicals has, in general, been taken as a measure of their efficiency in controlling pests.

10.3.13 Individual studies, assuming that they have been made under the same fertility conditions, are generally concerned with a particular chemical or chemicals. All other incidences have, however, to be recorded. In order to obtain maximum efficiency in controlling insect pests and diseases, it is necessary to find out the feasibility of using an insecticide, a fungicide and a weedicide at the same time, depending on the pest situation of the region.

10.3.14 The dosages of chemicals, number of applications and time of application are important factors in determining the efficiency of chemicals. Successful control is based only upon the correct identification of the pests, accurate knowledge of the life-history and habits

of the organism concerned and host-parasite inter-action. Also important are the critical stages of the host plants and pest intensity for regulating the use of the chemical and obtaining the maximum efficiency. Unlike fertilisers, these chemicals are ordinarily not known to have any direct effect on yield increase. But some studies have shown yield increases on controlling pests, which have not been directly correlated with the losses in yield caused by pests. Some of the chemicals used may have growth promoting power. It is practically impossible to have a total control of pests. Hence, all future studies should preferably be correlated with the losses caused by various pests under different conditions and in different regions. This would enable to arrive at a good estimate of loss.

10.3.15 The work of evolving pest resistant crop varieties is time consuming. The greater the tolerance of varieties, the greater would be the reduction in pesticide requirement and thereby reduction in pollution risk. But, with the development of resistant/tolerant varieties of crops, insect pests and pathogens evolve more virulent strains making the search for such varieties a continuing process.

10.3.16 Plant protection chemicals belong to a wide variety of groups and are of varying compositions. The main requirements for the satisfactory application of a chemical, used either for spraying or dusting, have been laid down. The combination and compatibility of all the additives with the active constituents should determine the potentiality of a chemical for pest control.

10.3.17 There is a need for the development of compounds and methods with an eye to economise on materials and number of applications. The present trend in crop spraying is to apply more concentrated pesticides by means of low volume sprayers. Another technique, which suits aerial spraying, is to use Low Volume Concentrate (LVC) pesticides in undiluted form as Ultra Low Volume (ULV) sprays. Granular formulations have a great scope because of their promise in rapid increase of coverage, efficacy and ease of application, accurate control of rate and placement and are safer to applicators and other desirable forms of life.

Chemicals in Farming System : Surveillance and Warning

10.3.18 Insect pests and diseases of crops do not, as a rule, reach epidemic proportions suddenly. A systematic and periodical inspection of crops would provide a check before they do so. A timely warning to the cultivators while the pests are in easily controllable stages, would enable them to reduce damage without much expenditure. With changing cropping patterns, pest surveillance should become an

integral part of crop production. New crop introductions which are likely to bring hitherto unknown pests should be watched cautiously.

10.3.19 The first unified attempt at pest surveillance in India was the Wheat Diseases Surveillance which has been in progress since 1966-67. Following this, the Plant Pests and Diseases Surveillance Service was organised in 1969-70 in four selected districts under the Intensive Agricultural District Programme (IADP). The *ad-hoc* Rice Survey ,Surveillance of Pests and Diseases of Rice, was similarly organised during the kharif seasons of 1970, 1971 and 1972.

10.3.20 The primary thrust of the Wheat Diseases Surveillance was directed towards three rust diseases and their effect on newly introduced high yielding varieties, whereas that of the *ad hoc* Rice Survey was directed towards monitoring the population of *Nephrotettix virescens* (Distant) (formerly *Nephrotettix impicticeps* Ishihara), the vector of tungro virus, and recording its occurrence in relation to the vector population.

10.3.21 Wheat Diseases Surveillance has provided very useful information which may be used to build up a disease forecasting system, as is being done in respect of black rust movement. The information gathered during the three survey seasons in respect of the *ad hoc* rice survey enabled to indicate the occurrence of tungro virus. The two surveillance programmes have clearly demonstrated that information can be gathered from numerous farmers' fields in the wheat and rice growing tracts. The experience suggests that for the success of such programmes freedom to travel and transport facilities for collecting information from the field should be ensured. There is a need to have the surveillance programme continued throughout the year beyond the wheat growing season, particularly in the hills, for getting a clear understanding of the inoculum potential, perpetuation survival and movement of rust spores. The *ad hoc* Rice Survey should be placed on a permanent footing for the 'off-season' surveys to be carried out preferably in the endemic areas. It has not been established yet how the leafhopper continues its existence in the next seasons, when in most cases, there is only one crop and the summer temperature is high. Other problems of insect pests and diseases could be similarly tackled by means of direct approach.

10.3.22 The objectives of the Pests and Diseases Surveillance Service are : (a) to assess the methods used for surveillance of insect pests and diseases and if possible, to develop better survey methods; (b) to gain knowledge about the distribution of insect pests and diseases and the levels of injury inflicted upon the host plant with a view to getting the control operation initiated as soon as it crosses the economic threshold of damage; (c) to establish a co-

ordinated system of detection and surveillance of the major crop pests in the country which would assist in timely and effective mobilisation of plant protection facilities for pest control; and (d) evaluate the feasibility of the system of surveillance within the structure of the State agricultural organisation.

10.3.23 Central Pests and Diseases Surveillance Stations have been set up under the Directorate of Plant Protection, Quarantine and Storage (DPPQ&S) in 12 districts in the country with 72 observation posts and 12 posts in each of the 6 selected blocks of the district. In the Fifth Plan, seven additional stations have been proposed on a similar set up.

10.3.24 At present the methods given in Plant Pest Diseases Survey Manual for Plant Protection Workers' published by DPPQ&S forms the basis of training. With the experience gained during large scale adoption of methods given in the Manual, need has been felt for a thorough re-examination of the techniques and procedures of sampling stated in the Manual for the purpose of improving on them.

10.3.25 For various reasons, in none of the 4 IADP districts the programme came up to expectations. Some of the reasons appear to be lack of proper appreciation of the objective of the programme, lack of staff exclusively for the programme, and adequate outside support, temporary nature of the programme, etc. However, the programme is being well implemented by the Central Stations and efforts are being made to improve on the working in the IADP districts. While some information exists on the correlation between pest build up and agro-climatic conditions, a much more systematic study would be required to ensure accuracy of the forecast put out by surveillance stations. To get the best out of the surveillance system, it would be necessary to build up effective warning procedure and for this it would be necessary to determine the economic threshold of the major pests. Occurrence of major insect pests and diseases and the distribution of species, exact times of occurrence, varieties of crops affected, plant growth stage preferred etc. would have to be studied in details. The minor insect pests and diseases should not, however, be ignored because they may require attention in course of time.

10.3.26 Too little is known about many of the insect pests and diseases to provide the basis for developing sound techniques for sampling. Available techniques employed are often extremely difficult, mostly untried, and time consuming. Any surveillance project should continually strive to find methods suitable for determining the occurrence of each individual insect pest and disease. This activity should either be a part of the research work being done, or the subject of new research projects. Most of the activities connected with surveillance

are not indeed directly related to forecasting and even though the data collected in course of surveillance are not enough to issue warning to farmers, they are sufficient to indicate the magnitude of the problem.

10.3.27 The chances of introductions of new plant diseases and insect pests, etc. have increased in view of the high speed of communication and the desire to bring in improved varieties of seed to quicken agricultural production. Strict quarantine measures are enforced by international agreement to prevent such inadvertent introductions. Considering their great responsibility, the officers entrusted with the task of keeping vigil should be given all possible facilities and encouragement to carry out their obligations.

Economics of the Use of Agricultural Chemicals

10.3.28 For an estimate of the economics of pesticide use, it is necessary to know the cost of chemicals and the yield increase due to pesticides. It is not easy to rigorously separate the yield components and assign each to the various inputs. Under average conditions the yield increase due to pesticides may vary from 10 to 40 per cent. If the price of that much of produce is more than the cost of chemical one can safely say that the treatment is economic. The commonly used pesticides schedule is so variable even for a single crop that the calculation of economics is difficult. If done approximately the values arrived at may be misleading. In spite of the difficulties and uncertainties some attempts have been made to evaluate the benefit-cost ratios of pesticide treatments.

10.3.29 The National Council of Applied Economic Research (NCAER) carried out benefit-cost analysis of pesticide treatment, based on experimental data furnished by State Entomologists and Plant Pathologists. It was observed that the benefit-cost ratio was markedly high in the case of seed treatment, due to the low cost of seed treatment while it was comparatively low in the case of post-sowing treatment because of its relatively high cost; even so, it was impressive. The net benefit per hectare was much higher in the case of post-sowing insecticidal than fungicidal treatments. This study has limitations in that the variations of yield between treated and untreated plots were not significant, precisely because pest infestation was not severe on the untreated plots. Other complicating factors, such as inadequate, excessive or untimed rainfall, weed competition, small number of experiments etc., made it difficult to gauge from the above analysis the benefit attributable exclusively to pesticide use. Various other research workers have also attempted to find out the benefit cost ratio of pesticide treatment which bring out clearly the benefits arising out of plant

protection measures. The values vary because the conditions of experiments and the methods of assessment are not identical. A more accurate estimate of the benefit-cost ratios should, however, be obtained by carefully carrying out a large number of field experiments (result demonstrations) which would enable analysis of the data according to crops and treatments. With fluctuations in the cost of pesticides and labour and return from produce, the benefit-cost ratio would vary. But even then such estimates are of value as a rough guide to assess the economics and benefits of pesticide treatment.

10.3.30 The PEO study in 1962-63 has shown a wide gap between the awareness and adoption of chemicals as reflected by the very small expenditure (2.2—2.5 per cent of inputs) on plant protection measures. Consequently significant losses were caused to crops. "Pesticides Market Studies" undertaken by the 11M in cooperation with USAID for the districts of Guntur, Ahmednagar, Mehsana and Shahabad show that on an average for a district, a farmer does not spend more than Rs 7.45 per hectare on pesticides for food crops, whereas he invests much more on the same items for cash crops. The highest expenditure is recorded in Guntur where cash crops predominate and the lowest in Shahabad. In reply to the Commission's questionnaire on plant protection most of the States have reported a fair degree of awareness on the part of farmers towards benefit of pesticides use.

10.3.31 The adoption of pesticides seems to be governed by economic factors. In general, the big farmers who use fertilisers adopt pesticides earlier than the small farmers. Prophylactic treatment is not common with the farmers except those who go for high value commercial crops. They are no doubt convinced of the benefit of pesticide use but awareness of the magnitude of damage caused by pests seems to be lacking. In fact, the comprehension of farmers regarding pest affected areas or the lack of it, seems to govern their pesticide expenditure. It is, therefore, necessary to bridge the gap between awareness and actual adoption of measures for plant protection. This gap could be bridged by State Departments through large scale extension methods. The State departments should review their plant protection set-up, especially the extension unit, and streamline the organisation for this purpose. The pesticide industry should also undertake intensive efforts to educate farmers.

Assessment of Requirements of Agricultural Chemicals

10.3.32 The popularity of BHC and DDT led to the indigenous manufacture of BHC in 1952 and DDT in 1954. Since then there

has been a remarkable progress in the manufacture of other chemicals. Fortytwo products of technical grade are being currently manufactured under different classes of pesticides.

10.3.33 The trend of consumption of major groups of indigenously produced pesticides (except fumigants) during the period 1954-1971 illustrates the remarkable increase of insecticides consumption from 434 tonnes to 22,013 tonnes in 17 years. On the other hand, the consumption of fungicides and herbicides increased from 598 tonnes to only 2067 tonnes and from nil to only 30 tonnes respectively. Of the insecticides, chlorinated hydrocarbons constitute a substantial proportion followed by the organophosphorus compounds. Amongst the fungicides the use of copper compounds and organomercurials has declined, but that of thiocarbamates has shown a steep increase.

10.3.34 Besides increased production within the country, plant protection chemicals have been imported to supplement indigenous production. Information on the import of pesticides does not specify all the chemicals imported. None of the States appears to maintain a complete record of the types of chemicals and quantities consumed annually. There is no uniformity in the maintenance of records. Hence, from the available information, neither the position in regard to use of pesticides nor its trend during the years could be ascertained. It is important that the States should maintain a complete yearwise record, in a uniform manner, of all the plant protection chemicals actually being consumed both at the governmental level and those distributed through private and other agencies. A systematic record should not only give the amounts of insecticides, fungicides, herbicides, rodenticides, etc. but also state the various groups of chemicals, as well as individual chemicals. The need to maintain such records with the DPPQ&S cannot be overemphasised. This would help the Government/industries in planning to meet the bulk of the country's demand of various chemicals through indigenous production and, if necessary, through import.

10.3.35 The Pesticides Association of India (PAI) maintains all India consumption figures, based on the materials sold by the pesticides industry as well as the Government from stocks of domestic production and imports. The total sales are assumed to be consumed. But there is no breakup of the consumption data on the basis of crops or regions or groups of pesticides. Initially the consumption of pesticides in the country was low, only 2,350 tonnes in technical grade by the end of the First Plan. There has ben substantial increases in consumption since then though at varying rates. Even though the rate of increase in consumption of pesticides varies, that of consumption per unit of gross cropped area has ben growing. In 1955-56, 15.9 g

pesticides per hectare was consumed which in 1971-72 rose to 180.1 g pesticides per hectare. Comparing this with the consumption figures of developed countries, it is still very low.

10.3.36 Two factors are patently responsible for increasing demand for pesticides : (a) the growing emphasis on using plant protection measures; and (b) the increased area under high yielding varieties which, being relatively more susceptible to pests than the traditional varieties, require considerable amounts of plant protection chemicals. Till the end of the Third Plan, it was considered that only a certain percentage of the gross cropped area was required to be covered under plant protection but the Fifth Plan formulation indicates that the estimated areas to be covered at the end of the Plan would be 100 Mha, comprising seed treatment (21 Mha), rat control (12 Mha), weed control (4.5 Mha) and intensive treatment on surface and soil pests (62.5 Mha).

10.3.37 The replies from the States on the future trend in consumption of pesticides are neither uniform nor do they give a complete picture of the type of chemicals and quantities that would be required. Moreover, the method of assessment of the requirement by the States has not been uniform. Hence, not even a rough estimate is possible of the requirement of chemicals on the basis of the information given. It is essential that all the States record their requirements on a uniform basis and report accordingly. The requirement should not only include those reported at the Government level but also those by other agencies.

10.3.38 The total requirement of chemicals of the end of Fifth Plan has been estimated about 0.105 million tonnes in terms of technical materials taking into consideration three aspects, viz, (a) pest problems of major food, cash, plantation, fruits and other crops, (b) choice of chemicals and dosage as per State Government's plant protection schedules; and (c) preference for indigenously produced pesticides. Also, the coverage under different groups of crops was kept in view. The requirement is estimated to go up to 0.14 million tonnes by 1985-86 assuming identical conditions. These estimates are too approximate because of the lack of necessary data and the *ad hoc* assumptions made for the calculations.

10.3.39 There appears to be no relation whatsoever between the recommended chemicals in the plant protection schedule and the consumption and requirement of chemicals as received from the States. Moreover, the recommended plant protection schedules made available by the States do not conform to the pest problems as published in the literature. The present plant protection schedules should, therefore, be revised immediately, making it obligatory to revise them every two years. The State surveillance agencies should maintain records of

cropwise pest problems together with the time and intensity of attack. In the long run this information would be of use not only to assess more exactly the requirement of chemicals but also to plan control operations more systematically.

10.3.40 There should be a rational approach to assess the relative merits of various pesticides based on performance and cost of treatment. The type of equipments needed, such as, for seed treatment, dusting, spraying etc, and their availability and the cost of treatment. The location of endemic areas is important for which there should be provision for sudden outbreaks, and an upto-date inventory of available stocks both with Government and private agencies is imperative. The plant protection units of the States should be reorganised to collect and evaluate data on pest problems, cropwise and seasonwise; of the endemic areas, if any; and of the pestwise requirements of chemicals. They should accordingly be armed with the necessary equipment, machinery, trained personnel and other facilities to fight sudden outbreaks and emergency situations.

Basic Raw Materials, Knowhow and Indigenous Availability

10.3.41 Some of the main raw materials and intermediates like hexachlorocyclopentadiene (HCCP) and butanediolacetate required for indigenous production of some chlorinated hydrocarbon insecticides; maleic anhydride, ethylmercaptam, metacresol and orthophenylene-diamine for organophosphorus insecticides; catechol (or pyrocatechol) and methylchloride for two carbamate insecticides; 2-mercaptoethanol and thiophenol for fungicides; and 4,4-bipyridyl, propionic acid, 2,6-diethylaniline, N-isopropylaniline, 3,4-dichloroaniline and arsenic trioxide for some weedicides, are not available within the country. They will, therefore, have to be imported till their indigenous production is established. All other raw materials required are indigenously available. Research and development projects could be undertaken to develop their know-how. Regarding other groups of pesticides like acaricides, nematicides and plant growth regulators, certain products have been identified and their knowhow is being developed by the National Chemical Laboratory (NCL) and other regional research laboratories. All raw materials and intermediates are indigenously available.

10.3.42 No evidence is available in the country to develop newer pesticides either by the industry or research institutions. So far, for almost all the products being manufactured indigenously, the knowhow was developed in foreign countries. Whatever research efforts are being made by the industry are primarily directed towards formulation

of products. Efforts are needed to develop knowhow for the manufacture of intermediates, active technical pesticides and their formulations.

10.3.43 The cost of indigenously manufactured products is higher than the international prices, whether manufactured with indigenous raw materials or with imported ones. The Government allows the import of chemical raw materials and intermediates at 20 per cent customs duty to encourage basic manufacture. The import of chemical intermediates, if available indigenously, is banned to help the local manufacture of basic pesticides. In many cases, the prices of raw materials of indigenous origin are generally much higher than the international prices, leading to high costs of indigenously manufactured products. In such cases, either the Government allows import of chemicals from the cheapest source, or makes them available at a subsidised rate. It is, therefore, necessary to have complete costing before any manufacture is undertaken in the country. Further, there should be a probe in depth to find out why the indigenous manufacturers are so much costlier than the international products.

10.3.44 The more important naturally occurring insecticides are nicotine, pyrethrin, rotenone, and petroleum oils. They are generally unstable towards light, air, moisture and alkali and the residues deteriorate rapidly after application. High cost of application and non-availability in sufficient quantity are some of the stumbling blocks in their usages as plant protectoin chemicals in agriculture, but they have advantages, unlike most of the synthetics, of selectivity, efficiency and easy biodegradation. Research work on naturally occurring pesticides and on products synthesised from them and having desirable stability should, therefore, be intensified.

Fertiliser Pesticide Mixture

10.3.45 In the case of most crops the critical stages of growth, which coincide with the maximum uptake of nutrients, often happen to be the vulnerable stages of pest attack. The application of certain fertiliser chemicals, e.g. urea, on such occasions in spray form may be combined with pesticide chemicals, thereby saving application cost. Such application has resulted not only in control of pests but also in increased yields. The combined fertiliser pesticide sprays have so far been confined to certain localised areas having large contiguous blocks. Possibilities of such combined sprays have not been explored in small areas having fragmented lands. As ready-to-use mixtures, these can be applied like any other spray chemical following specific instructions for application.

10.3.46 Since the systemic pesticides can be absorbed through foliage as well as by roots, the possibility of applying fertiliser pesticide mixtures to the soil should be investigated. Apart from urea, the possibility and desirability of mixing other nitrogenous, phosphatic and potassic fertilisers, most of which are ionic, are matters of further investigation. For example, studies should be undertaken to find out (a) the conditions for a homogenous mixture; (b) reactions which affect the efficacy in the mixture of either the plant nutrient or the protection chemical or of both; and (c) keeping qualities of the mixture in storage.

10.3.47 While dealing with the quality aspects of fertilisers in the Interim Report on Fertiliser Distribution, it has been suggested that the ISI should bring out standards for fertiliser-pesticide mixtures in anticipation of their becoming a part of the future consumption pattern alongside the use of more and more complex granulated fertilisers. It is further suggested that a committee of representatives from the agricultural universities, ICAR, IARI, DPPQ&S, ISI and the fertiliser and pesticide industries should be formed to take up a thorough study of fertiliser pesticide mixtures in relation to the pattern of future consumption of both fertilisers and pesticides, changes in cropping patterns under various agroclimatic conditions, pest complex and cost of application.

Residual Toxicity and Hazards of Pesticides

10.3.48 The spectacular lethal action of pesticides against insect pests and diseases has encouraged their use throughout the world. In view of the increased emphasis on food production, application of these substances has been on the increase. Unfortunately, pesticides are mostly poisonous and hence, of utmost concern in regard to pesticide use are their toxic residues. Hazards associated with the use of pesticides manifest in chronic or acute toxicity in man. Probably chronic toxicity of pesticides involves the entire population while acute toxicity affects only those who are involved in the trade, manufacture, formulation and application of pesticides.

10.3.49 Among pesticides, the insecticides have been particularly causing concern with regard to their residual toxicity. Out of these, the residual toxicity of DDT, BHC, aldrin, dieldrin, endrin, chlordane, methoxychlor, toxaphene, etc. is known to be highly persistent. Accidental dangers are not so frequent and are often preventable through proper education and precautionary measures. They should not, therefore, be set against the use of pesticides.

10.3.50 The reports about small quantities of DDT in human body

fat with no known direct exposure to DDT raise the question of these compounds being ingested with the normal food. DDT and other insecticide residues have been reported in various foods, milk products and other animal products. There is a need to make a careful survey of the organochlorine insecticide burden in the body fat. Studies on residue tolerances have been made adopting data from FAO/WHO Pesticides Committee, FAO/WHO Food Standards Programme and Codex Alimentarius Committee. They are under constant scrutiny and liable to modification as more reliable data become available. Tolerance limits for all pesticides used in the country should be ascertained and also those of 'Acceptable Daily Intake' and residue tolerance of different pesticides under Indian conditions. The information available in India on the monitoring of pesticide residues in food-stuffs though meagre suggests the possibility that gross contamination could occur. Therefore, there is an urgent need to monitor, especially in areas of intensive use of pesticides, foodstuffs for pesticide residues, which should include, besides foodgrains, vegetables, fruits, milk, meat, oils, fats and animal feeds, waters from rivers, fish ponds, lakes, wells and canals.

10.3.51 Most of the pesticide residue surveys have utilised one analytical procedure, viz., either colorimetric method or thin layer chromatography or gas liquid chromatography. The need for using multiple analytical procedures to confirm the identity of the components is necessary. Facilities for more sophisticated techniques like infrared, ultraviolet, and mass spectrometry should be made available. It is known that the degradation of pesticides is influenced significantly by climatic factors. India is a vast country with diverse climate and it is, therefore, necessary that facilities for such studies are provided and developed at a number of locations. Further, studies so far made have been restricted to the estimation of the parent compound. Most of the pesticides undergo change after application to the soil, crop, or livestock and some of the metabolites may be even more toxic than the parent compound. The potential toxicity of the treated food can only be known if the nature and extent of the terminal residues are studied in detail. In order to study the terminal residues, facilities of tracer techniques, bio-chemical methods and modern analytical tools need to be developed.

10.3.52 Recognising the upward consumption of pesticides in the country, it is necessary to gradually discontinue the highly toxic ones now in use, which have no industrial base in the country, and to find out more suitable and safer substitutes. Also research and development of less hazardous and superior formulations have to be encouraged and emphasis should be laid on the development of indigenous

knowhow of manufacturing pesticide chemicals from indigenous sources. It has been noticed that there are different plant protection schedules prevalent in the country. These schedules are to be re-examined from the point of view of pesticides residues.

10.3.53 The integrated pest control strategy aims at optimisation of the natural controlling factors. In the integrated control method, the ecological selectivity of chemicals may be taken advantage of to make discriminative use of them to develop effective, economical and as far as possible ecologically sound control methods. For this purpose, knowledge of ecology, biology and behaviour of pests and their natural enemies, crops and crop complex, and characteristic properties of chemicals is required. More important is the need of experienced crop protection specialists. In order to minimise pollution hazards, more and more nonpesticidal control methods have to be devised and suitably integrated with chemical methods. The control of locusts is an example of large scale application of the integrated method of pest control.

10.3.54 Stored grains may be damaged by one or more of the following causes : (a) dampness; (b) temperature variation; (c) rats; and (d) insects, mites and microorganisms. The damage caused by rats may be prevented if done on a campaign basis, by storing grains, in ratproof godowns provided with rat poisons and traps*. By controlling moistures and oxygen contents and temperature variations, storage structures can be suitably made to prevent pest infestation to a considerable extent, and in many cases no insecticide would be necessary. Fumigation of grains and storage structures or godowns with chemicals like ethylene dibromide, ethylene dichloride, methyl bromide, ED/CT mixtures, etc. is one of the safest ways of disinfecting grains provided the proper choice of fumigant is made. Potent pesticides like DDT, BHC and malathion are commonly used but because of their persistence and toxicity, the use, if at all, should be confined to the preservation of seeds alone. Of the nonchemical methods, the control of storage pests by using the sterile male techniques has shown great promise and deserves to be fully explored.

Quality Control of Pesticides

10.3.55 Complaints have been received from different States that in a number of cases pesticides received by the farmers are of sub-standard quality and appear to be adulterated. Difference in selling price by Government agencies and private dealers may tempt unscrupulous dealers to indulge in adulteration, particularly when the demand

*See Chapter 12 also.

is more than the supply. Determination of shelf-life and introduction of effective methods for the storage of various pesticides are equally important to maintain the quality.

10.3.56 The large producers of pesticides have facilities for analysing their products so that the desired quality of the final products is ensured. No suggestions for quality control at manufacturers' level have been put forward by the States. It is felt that all bags containing formulated pesticide dusts should be of uniform standards and machine stitched with metal seals. Other formulated products in metal containers and glass bottles should be made pilfer proof. Moreover, batch numbers should be printed or stamped on the labels of containers or bags, as the case may be, to facilitate sampling by Insecticide Inspectors and the Insecticide Analysts in checking the quality of pesticides under the provisions of the Insecticides Act. It is also necessary that the ISI should address itself as quickly as possible to establish standards for pesticides wherever such standards are not available. The manufacturers should be induced in their own interest to come under the ISI Quality Marking System.

10.3.57 Methods of sampling and analysis need to be standardised and improved upon from time to time based on experience. These methods should be uniform throughout the country and brought within the scope of the Insecticides Act and the Quality Marking System of the ISI. All methods should be subjected to periodical scrutiny for the purpose of incorporating latest modifications and improvements as and when necessary. Almost all the State Governments have favoured the constitution of a Central Committee of Analytical Chemists to undertake the task of formulating standard methods of analysis and exercising periodical reviews. The Central Insecticides Laboratory, when established could very well disseminate up-to-date information to the State laboratories when also established. The Central laboratory should also have arrangements for training quality control personnel engaged in drawing and analysis of pesticide samples.

10.3.58 Almost all the States have complained about non-availability of rapid testing techniques and equipment. Quick tests which would stand the requirements of legal proof are still not available. There is, therefore, a need to develop faster analytical procedures and to equip the mobile soil testing laboratories to carry out preliminary pesticide analysis. Samples found substandard may thereafter be subjected to conventional methods so as to take necessary legal action under the Insecticides Act.

10.3.59 At present, research work on various aspects of quality control of pesticides is being carried out only at the Division of Agricultural Chemicals, IARI, New Delhi. Additional pesticide analysis

laboratories, which are likely to be set up in future, should preferably be located in the campuses of the agricultural universities, so that the latter can assist the laboratories in an advisory capacity.

10.3.60 In order to educate the farmers with regard to the existing facilities available for the testing of pesticides and in distinguishing the standard materials from the spurious ones, the use of publicity media, like audiovisual aids, posters, film shows, advertisement in local newspapers, television and radio programmes etc. should be undertaken. The Insecticides Act and the Insecticides Rules should be translated into regional languages and made easily available to the farmers.

10.3.61 Recommending one out of different but equally effective brands of the same pesticide and its formulations would discourage competition. The quality control laboratories should keep a check on quality of various brands and be able to suggest alternative forms of pesticides, such as dusts, wettable powders, emulsifiable concentrates or granules. Most of the pesticides are generally required in small quantities. If, therefore, whenever possible small amounts instead of bulk quantities are made available in tamperproof containers the risk of adulteration may be reduced. This arrangement would, at the same time, enable even small farmers to buy pesticides which they cannot afford if sold in bulk.

10.3.62 The setting up of a Central Pesticides Release Committee as suggested by some is likely to duplicate the functions of the Insecticides Board and the Registration Committee. Moreover, delegation of the functions of the proposed Committee would prevent enlargement of the functions of the Insecticides Board and the Registration Committee. Most of the States are not in favour of a Central Pesticides Release Committee.

Plant Protection Service

10.3.63 The system of distribution of pesticides is becoming more important with their increasing use. The distribution is being handled by various agencies, most important being the State departments, co-operative societies and private traders. The total number of distribution centres run by private and cooperative societies and Government agencies is at present about 32,000 which are supposed to cater for more than 600,000 villages, i.e. there is one depot for 19-20 villages. These figures speak of a poor distribution system which needs to be geared up.

10.3.64 Private agencies are at present handling nearly 60 per cent of the distribution work. Bearing in mind that the cooperatives need support till they can stand on their own, the State departments

should render necessary assistance and continue distribution of pesticides till the cooperative societies become self-sufficient in the business. State departments should also keep emergency stock of popularly consumed pesticides. A recent decision of the Government of India to entrust the State departments with 50 per cent technical grade material of commonly used ten pesticides would help the States maintain the supply line.

10.3.65 The remedial measures to correct such imbalances as occur between demand and supply seem to be (a) to increase local production; (b) to import pesticides well in advance; and (c) to streamline distribution system. In addition, State departments should maintain emergency stock to guard against natural calamities and unforeseen situations. All stocks lying with various distributing agencies should be occasionally checked. Difficulties arising out of untimely financial allocations could be overcome by taking steps well in advance.

10.3.66 The PAI surveys carried out in Maharashtra, Gujarat, Bihar and Himachal Pradesh have shown that cultivators have to travel long distances to obtain their supplies of pesticides. It has also been observed that distribution centres are generally opened in demand areas and that places which are easily accessible by railway or road are preferred as new distribution centres by private traders. These drawbacks may be remedied if, while issuing licences, equal opportunities are given to all categories of farmers, especially the smaller ones. It is further to be seen that the sale points are not dispersed too widely. Distributors may approach young farmers for opening sale depots in villages offering suitable commission on the sale of pesticides. The farmer's service society, recommended in the Interim Report on Credit Services for Small and Marginal Farmers and Agricultural Labourers, may be entrusted with the task of running input depots including those of pesticides, so that they become available in time to the members of the society.

10.3.67 Road transport of pesticides is considered safer and more efficient but is more costly than railway transport. The chief bottlenecks with railways are shortage of wagons and the low priority given to pesticide movement as compared to fertiliser. Further, transport problems arise due to long distances of sale points from user villages. The same priority, as given to fertilisers, should be extended to pesticides in the matter of allotment of railway wagons and their movement. Pesticides should be transported in closed wagon so that damages due to bad handling are avoided.

10.3.68 Some of the storage places used by the private traders, State Agriculture Departments and cooperative agencies are far from satisfactory and chemicals stored in them are likely to deteriorate in

quality. The godowns and storage facilities available with agencies like the Fertiliser Corporation of India should be given on a priority basis for pesticide storage also. There should be proper facilities for storing at the port and railway terminals in order to minimise the loss due to adverse weather conditions especially during the monsoon.

10.3.69 Subsidy, whatever be its form and amount, was meant to popularise use of pesticides. Now that farmers are conscious of the benefits of plant protection, most of the States are in favour of discontinuing subsidy for purchase of pesticides. Subsidy should be discontinued except in the case of small and marginal farmers. It may, however, be given (a) for transportation charges of pesticides from rail heads to distribution points for stabilising prices; (b) for aerial spray; (c) for appliances; (d) for spraying pesticides in epidemic areas; and (e) for opening more sale points in backward areas.

10.3.70 It is observed that the present state of promotional efforts made by State Governments in the form of plant protection demonstrations, mass meetings, distribution of popular literature, pamphlets, booklets, charts, guides, radio broadcasts and seminars etc. are not satisfactory. A part of the savings accruing from withdrawal of subsidy should, therefore, be utilised for promotional activities such as the training of farmers, demonstration in farmer's fields, custom service, opening suitably located sale points, provision of technical guidance regarding use of pesticides and their harmful effects, besides usual extension services.

10.3.71 Plant protection work is mainly handled by the Directorate of Plant Protection, Quarantine and Storage (DPPQ&S) of the Union Ministry of Agriculture and Irrigation, and the Agriculture Departments in the States. DPPO&S is headed by the Plant Protection Adviser to the Government of India, who also functions as the Director, Locust Control. He is assisted in his work by a Deputy Director, Assistant Directors and other officers and different categories of technical and administrative personnel.

10.3.72 The DPPQ&S is involved in multifarious activities and responsibilities all of which, are of highly technical nature. Responsibilities, and functions are, however, efficiently and more satisfactorily carried out if commensurate powers of taking decisions and implementing them are vested in the officers concerned. Keeping this in view, the status of the DPPQ&S should be upgraded so that the Plant Protection Adviser, like similar other Advisers in the Government of India, enjoys the status of a Joint Secretary.

10.3.73 Most of the States have separate plant protection organisations under the Agriculture Departments. But there is no uniformity in the staffing pattern of different States. For the sake of uniformity in

the administrative setup and the importance of plant protection work, the status of the Plant Protection Officer at the State level should be that of a Deputy Director of Agriculture. In the Interim Report on Fertiliser Distribution, an officer of the rank of a Joint Director has been recommended to be incharge of supervising, distributing and regulating use and quality of all inputs, such as fertilisers, plant protection chemicals, seeds, etc. The Joint Director having specialisation in any of the inputs would have immediately below him a number of input specialists having the status of Deputy Directors. At the divisional, district and block headquarters, plant protection work may be looked after by Plant Protection Specialists of Class I and Class II status and graduate specialists respectively.

4 FARM POWER

10.4.1 The main sources of power for agriculture are human labour, draught animals and machines. Though requirement of power for achieving satisfactory levels of production varies from area to area, depending upon factors like climate, soil and other endowments, there is a positive relationship between farm power availability and future productivity. In this section, the present availability and future requirements of farm power for crop production including fodder cultivation and the major operational constraints having a bearing on farm productivity have been considered. The power needs of dairying are expected to be met by the expansion of electric power. Those of fishery and forestry are of a specialised nature and have been considered in the relevant chapters.

Farm Power and Productivity

10.4.2 The Commission made an assessment of availability of farm power from different sources, district-wise and in terms of their horse power equivalent*. For estimation, only 80 per cent of human and animal power has been assumed to be available for agricultural operations allowing for time spent by agricultural labour and draught animals on extra-farm activities. Likewise only 50 per cent of tractor power has been credited to agriculture as its present use is confined mainly to tillage operations.

* Horse power equivalents assumed are : man: 9·07 hp .woman : 0·05 hp; bullock : 0·04 hp ; tractor : 25.00 hp; power tillbr : 7·00 hp; deisel and electric motors : 6 to 7 hp; and power sprayers: 2·00hp.

The overall position of farm power availability in 1971 was as follows :—

Source of power	Availability	Hp/ha
Human labour	87·4	0·04
draught animals	63·3	0·18
tractors and power tillers	2·41	0·11
other machinery	0·07	0·01
	0·34	0·01

10.4.3 The highlights of the district-wise analysis were :

- (i) average availability of farm power in the country from all sources was 0.36 hp/ha in 1971. Over 62 per cent of it was contributed by human labour and draught animals and the remaining by farm machinery. The share of tractors in the latter was hardly 4 per cent and that of pumpsets was 32 per cent;
- (ii) 53 per cent of the districts had less than 0.4 hp/ha of farm power and 86 per cent less than 0.6 hp/ha. Only 20 district out of 317 considered had power of 0.8 hp/ha or more, of which 9 were in Punjab and 3 each in Tamil Nadu, Andhra Pradesh and Karnataka; and
- (iii) machine power available was less than 0.2 hp/ha in 79 per cent of districts and less than 0.4 hp/ha in 91 per cent.

10.4.4 A study of farm power requirements and availability in typical agro-climatic regions made with a view to assessing the adequacy of power available locally from traditional sources showed that there was power shortage in 4 out of the 5 districts studies at the time of sowing and harvesting. This being the position in districts where farming was comparatively backward, the imbalance would be further aggravated with widespread adoption of modern practices.

Requirement of Farm Power

10.4.5 The present strength of work animals, which was about 80 million in 1972 is expected to remain unchanged in 2000 AD. The anticipated level of net area sown in 2000 AD being 150 Mha and assuming that a pair of bullocks would manage efficiently 3 ha of farm area, the total area that could be taken care of by draught animals would be about 120 Mha, leaving a power gap equivalent to the needs of 30 Mha to be met by mechanisation.

10.4.6 Agricultural Census data for 1970-71 showed that holdings more than 5 ha accounted for 53 per cent of the area, of which 13 per cent belonged to large holdings of over 20 ha. While holdings of less

than 5 ha would continue to depend mostly on bullock for farm power, the larger holdings would need some mechanical power to supplement available power resources particularly holdings of 20 ha and above. The total exclusion of bullock from farm operations is not, therefore, considered likely even on very large farms from various practical considerations.

10.4.7 Bullocks are going to be maintained at the existing level even in 2000AD but their cost is likely to increase alongwith their improvement. There should be provision for extending loans by the Government to the farmers covering full cost of draught animals and difficulties as experienced by them at present, should be removed to assure easy and timely availability of advances. Credit cooperatives and commercial banks should also advance these loans.

10.4.8 As for human labour availability, the rural workforce is expected to increase from 139 million in 1971 to 250 million(excluding children) in 2000 AD out of which the strength of agricultural workers would be about 175 million. Assuming that 20 per cent of labour hours is utilised for nonfarm work, the number of hands available exclusively for farm work would be about 140 million, contributing 8.4 million hp to farm power on the basis of 0.06 hp per individual.

10.4.9 Three research studies were sponsored by the Commission on the question of unemployment *vis-a-vis* mechanisation, particularly tractorisation. A common finding of these studies was that tractorisation displaced mainly bullock labour and its impact on agricultural labour was less conspicuous, the displacement being 60 per cent and 15 per cent respectively. The limited displacement of human labour, however, should not be viewed in isolation as mechanisation opens up new avenues of employment in managerial and supervisory jobs on the one hand, and in the field of operation and servicing of farm machinery on the other.

10.4.10 Agricultural tractors of different types and power ranges would be needed to meet the requirements of 30 Mha of net sown area left unprovided with farm power. The relative requirement of different types of tractors are governed by factors like cropping patterns in vogue, soils, power needs of various crops and areas, consideration of suitability of machines in different areas, etc. The overall requirements of tractors by 2000 AD has been estimated at 2.28 million comprising two wheel power tillers (1.80 million), light tractors (0.28 million), medium tractors (0.12 million), and heavy tractors (0.08 million). On the assumption that the rate of utilisation of tractors would increase from 50 to 70 per cent by 2000 AD the total effective power available from these machines would be 18.34 million hp.

10.4.11 An important feature of these estimates is that power tillers have been provided for not only paddy areas but also other areas. The two-wheeled power tillers used mainly for puddling operations in paddy fields should also be designed for other light jobs like tillage of minor nature, water pumping and spraying and dusting operations. Because of its lightness and manoeuvrability, power tiller is considered suitable for operation even in hilly areas where it should be popularised. Adequate provision has also to be made for medium and heavy tractors which could be used for difficult jobs like land shaping, eradication of weeds and ploughing of sugarcane stubbles and hard soil like black cotton soils.

10.4.12 With the electrification of all the villages by about 1990 as envisaged in chapter 5, it would be possible to switch over to electricity not only for irrigation but also for many other jobs. For irrigation alone, it is estimated that about 9.5 million pumpsets would be needed by 2000 AD of which 8.5 million would be electric pumps and one million diesel operated. Electricity would also be used increasingly for operating chaff cutters, threshers, cane crushers etc. and for oil extraction, grain milling and other cottage industries. About 3.5 million electric motors would be required for the purpose by 2000 AD.

10.4.13 Resort to effective plant protection measures would become inescapable in future for maximising production. The most favoured equipment for the purpose would be the backmounted power sprayer duster with an average capacity of 2 hp. On the assumption that the number of these equipments will coincide with the number of operational holdings i.e. 8 million, it will contribute 16 million hp to the total power.

10.4.14 Farm power is also needed for undertaking certain non-repetitive jobs like reclamation, levelling, bunding, weed eradication etc. which are, by nature, arduous and power demanding. These are generally large scale operations organised mostly by the Government or public undertakings. Individuals could get their job done on payment. A comprehensive development of irrigation commands, where the work would range from land shaping and land development to construction of farm roads and other infrastructural facilities would require heavy machinery like bull-dozers, excavators, motor graders as well as tractors. It is estimated that about 30 Mha would have to be covered by these operations by 2000 AD. The overall requirement of bulldozers, excavators and motor graders, each with a capacity of 90 to 150 hp would be 2,700, 2,600 and 1,800 respectively, 2,300 tractors of 50 to 80 hp range, and 7,900 tractors of 20 to 50 hp range.

10.4.15 Based on the above, the number of men, animals, tractors, power tillers, engines and motors and power sprayers, which would

be needed by 2000 AD and their contribution to farm power in terms of horse power equivalents are indicated below :

TABLE 10·1
Farm Power Position—2000 AD

Source	Number million	Farm	Power	Availability
		in million hp.	per cent to total	hp 1000
(1)	(2)	(3)	(4)	(5)
men	140·00*	8·40	6·5	56·00
draught animal	64·00*	25·60	19·8	170·67
land development equipment	0·017	1·28	1·0	8·53
power tillers } tractors }	1·26 0·34*	18·34	14·1	122·27
electric motors	12·00	53·00	40·9	353·33
diesel engines	1·00	7·00	5·4	46·67
power sprayers dusters	8·00	16·00	12·3	106·67
Total	129·62		100·0	864·14

* Number effectively available for farm work.

10.4.16 The average power availability for the country as a whole in 2000 AD would be about 0.86 hp/ha. Electric motors required mainly for irrigation would account for about 41 per cent of the total, whereas the share of power tillers and tractors would be only 14 per cent. Draught animals would meet about 20 per cent of the farm power needs. It would be, however, necessary to ensure that fuel oil required for farm machinery is made available on a priority basis.

10.4.17 The estimates of average farm power requirements should be considered as tentative as they are based on extremely empirical data. In Taiwan, with a small farm economy and growing mainly paddy and where 60 per cent of the cultivated area is irrigated, the farm power available from different sources is only about 0.3 hp/ha. The fact that Taiwan could sustain a highly productive agriculture with only this much of power is a pointer that the present estimate of 0.86 hp/ha requires further study and analysis. A rapid mechanisation on the strength of this estimate would, therefore, be unwarranted. There should be detailed research and analysis to find out the fair requirement of farm power in various agro-climatic zones in the country under irrigated and nonirrigated conditions.

10.4.18 The efficiency of human labour and draught animals on the farms can be considerably enhanced by improving the implements that are in use. In fact this aspect should receive first priority in view of the utmost importance to the need for employment orientation in agricultural techniques. Any tendency to resort to use of machines

in labour surplus area in order to circumvent problems of labour management or which may result in lowering wages should be suitably controlled. Use of machines might be encouraged where there is serious shortage of human labour and draught animals.

Manufacture, Quality Control, Supply and Service

10.4.19 The licensed capacity with established firms for the manufacture of tractors is about 147,000 units per annum; in addition, Letters of Intent have been issued for another 41,000 units. If all these units start producing even at half the rate of the approved capacity, there would not be any difficulty in meeting the requirement of the country which is estimated at 0.48 million in 2000 AD. In the manufacture of tractors, it is, however, necessary to ensure that interchange of fast moving parts between different makes becomes possible in order to facilitate quick repairs and replacement. The Government should keep a constant watch on production to ensure that farmer's needs are met in full and the industry does not face any difficulty in regard to essential raw materials. In the case of crawler tractors used in land development work the installed capacity is adequate to meet future requirements. In this case, the primary need is to produce heavier machines of 150 hp than those of 50 to 90 hp range, which are being manufactured at present.

10.4.20 There are six power tiller units with a total licensed capacity of 40,000 units per annum so far. The present number of tillers in use is only about 10,000 whereas what is planned for 2000 AD is 1.8 million. A vigorous extension drive would be necessary to popularise the power tiller. Its utility and popularity could be greatly enhanced by making it more versatile. Side by side, steps should be taken to utilise fully the available capacity, further expand production in the existing units and examine the scope for diversion of excess capacity in tractor manufacturing units to the production of power tillers in accordance with the rising demand.

10.4.21 Lift pumps are being manufactured in various sizes and capacities by a number of manufacturers. In 1970-71, the installed manufacturing capacities for diesel engines and electric motors of the power range 3 to 10 hp were about 1.55 lakhs and 6 lakhs respectively, of which 4.25 lakhs was in public sectors. The estimated requirement of engines and motors is well within the capacity of the Indian industry to meet. Similar is the case with plant protection equipment.

10.4.22 Manufacturing licences are generally issued on the basis of test reports. However, facilities available for testing the performance of various farm machinery available in the country are limited.

Such facilities, therefore, need to be expanded at the tractor training and testing centres. A testing section should be developed at the Central Institute of Agricultural Engineering. Testing facilities should also be developed at some of agricultural universities depending upon the need. The Indian Standards Institution should lay down specifications for ancillary parts of farm power machinery.

10.4.23 The two major factors inhibiting the spread of farm machinery are the absence of the service and repair facilities and high cost. The sudden rush for tractors, pump sets, etc. in the wake of green revolution was not backed by proper service facilities. Most of the service and repair centres that sprang up did not possess the necessary facilities for providing efficient service. The hire-purchase scheme offers a satisfactory solution to the second inhibiting factor, viz. high cost. Already several nationalised banks have stepped in for financing the purchases of farm machinery by farmers. It is, however, necessary that loaning procedures are simplified and credit made more liberal to make it easy for farmers to purchase agricultural machinery.

10.4.24 Agroindustries corporations were set up in most of the States for assisting persons engaged in agriculture to own means of modernising their operations, and for distributing agricultural machinery and implements and processing equipment for different kinds of agroindustries. Their working shows that these corporations have been undertaking activities pertaining to the supply of inputs including farm machinery on the one hand, and entering on the other in such ventures in which it would have been ordinarily difficult to find other entrepreneurs. The latter set of activities are very desirable.

10.4.25 In so far as their role in farm machinery is concerned the primary concern of the corporations should be to ensure that manufacture of ancillaries, accessories and spare parts keeps pace with demand. They should undertake manufacture of only such items which are not manufactured by others or the production of which is not adequate and assist small and medium scale manufacturers by purchasing their stocks and taking over the responsibility of their sale upon themselves. The Corporations should offer two kinds of services, viz., custom service and workshop facilities for overhaul, repairs etc. For this purpose fufledged workshop should be established at each taluk headquarters, with some essential facilities arranged at assembling and submarkets. Private entrepreneurs should be encouraged to open workshops for farm machinery. They should also help them in developing facilities for community threshing and other post-harvest processing facilities in villages. The needs of small States and Union Territories which do not have separate corporations, should be taken care of by corporations of neighbouring States.

Organisation, Education and Research

10.4.26 The manpower requirement for operation and maintenance varies from one machinery to another. The tractor-man employment ratio from manufacturing to usage has been reckoned as 1 : 5, whereas that of electric motors is assumed as 5 : 1. On the basis of the varying requirements, the overall manpower requirement for the targeted machinery has been estimated at about 10 million by 2000 AD. The number includes agricultural engineers, diploma holders, technicians and skilled personnel. In addition, a vast number of farmers would also have to acquire competence to operate power machinery and take up on the spot maintenance jobs. While satisfactory arrangements exist in the country for graduate and post-graduate education in agricultural engineering, such facilities are highly inadequate in respect of middle level technical education and lower level training for mechanics. Equally inadequate are the arrangements available for giving operational training to farmers. The Agro-industries corporations can train a limited member of farmers but if required to handle a large scale programme of training they will not be able to pay adequate attention to their main activities.

10.4.27 Training of farmers in the handling of farm power machinery should be given by State Departments of Agriculture. The agro-industries corporations should not be burdened with extension work with regard to farm machinery. It should be the responsibility of the Agriculture Departments in the States who should provide duly qualified staff at the district, taluk and block headquarters for extension work. The manufacturing and workshop facilities envisaged for 2000 AD would necessitate introduction of diploma and certificate courses in agricultural engineering in the engineering polytechnics as well as in industrial training institutes.

10.4.28 The success of future mechanisation depends largely on developing an appropriate technology which fits in well between the traditional and modern technology. An adequate research base for producing more power machinery suited to Indian conditions is, therefore, very necessary. The manufacturers must create their own research and development units for the purpose and it should be the responsibility of licensing authority to ensure that they allocate adequate funds towards this end. The Central Institute of Agricultural Engineering, besides conducting its own research, should bring together agricultural scientists and engineers in order to determine problems and priorities. It should also coordinate research activities of the manufacturers and other institutions.

10.4.29 There is much speculation about the power needs for

maximising farm production. The need to undertake detailed research in this area has already been emphasised. The Central institute should undertake studies with the help of the Central/State farms to determine optimum levels of mechanisation under different conditions of soil, climate and irrigation and to collect information on related aspects.

5 FARM IMPLEMENTS AND MACHINERY

10.5.1 Some of the essential implements used in Indian agriculture are *khurpi*, sickle, spade, pickaxe, *desi* plough and *patela* and local models of hoes, harrows, cultivators, seed drills, etc. These indigenous implements have been evolved over generations, and have undergone little change.

10.5.2 Before the planned era, some attempts were made to introduce and popularise improved versions of some of the implements. With the advent of five year plans, increasing attention began to be paid to developmental work on implements with particular emphasis on the introduction of improved hand operated chaff cutters and winnowers and animal drawn implements such as mould board ploughs, cultivators and seed drills. Side by side, the necessity for carrying out research on indigenous implements and tools was also strongly felt. The ICAR set up regional research, testing and training centres (RTTC) at four places where work was started on testing and introducing implements like Japanese ploughs, disc harrows, seed drills, threshers, power tillers, decorticators, graders, shellers etc. In some of the specialised central institutes of the ICAR research work pertaining to machinery and implements specific to crops and regions was also undertaken.

Hand Operated and Animal Drawn Implements and Machinery

10.5.3 It is necessary not only to increase the power input but also introduce efficient matching implements and machinery for performing various farm operations. The data available from the All India Livestock Censuses indicate that even today there is predominance of traditional implements, particularly the wooden plough, and that the number of improved implements in use is comparatively small. The reason for this is not merely the conservative attitude of the farmers, but also the paucity of supply and service facilities. A detailed survey should be undertaken to ascertain the reasons for the slow acceptance of improved implements and machinery and the con-

tinued preference of farmers for the wooden plough.

10.5.4 The basic tillage implement commonly used by the Indian farmer is the plough, which has an extremely low efficiency of energy conversion into useful work. Attempts made to introduce iron ploughs have not been very successful. These ploughs, though two to three times more efficient than wooden ploughs of equivalent draft, have not been generally popular, except in a few pockets. For many years to come, bullock drawn plough will remain indispensable on farms in India. More attention should be devoted to the improvement of the wooden plough or to its replacement with a more acceptable iron plough. Efforts to develop suitable types of the plough for different conditions will also have to be made on a gigantic scale by building up the required research, manufacturing and extension organisations. In addition, the local artisans will have to be trained to repair and service the new types of ploughs.

10.5.5 Blade harrows are commonly used to prepare land, instead of the plough, in dry or semiarid regions, especially the black and medium black soil tracts. It is a good implement for secondary tillage like breaking clods and smoothening, and for preplanting weed eradication. Blade harrow is unique to this country and there is no improved implement which can perform similar work. It may not find a place in the paddy areas, but would be advantageous in the alluvial soils of the north. The reasons why the blade harrow is not finding favour in the northern alluvial tracts should be assessed and attempts made to introduce it in these parts in the existing or a modified form.

10.5.6 The implements frequently used for the preparation of land are not efficient enough to reduce the power requirements and drudgery. As a result, the yield levels are low and the cost of production is high. The use of levellers should be popularised in both rain-fed and irrigated areas to make water management more efficient. More attention requires to be paid to research on improvements in implements as also in the entire system of land preparation suited to different regions of the country. To popularise the use of these improved land preparation implements and make them available to the farmers, a strong extension organisation, backed up by appropriate supply and service facilities at the village level is also needed.

10.5.7 Ensuring a proper stand of crops in the field is by far the most important operation in farming. Methods and timeliness of sowing greatly influence germination, growth and the final yield. For this purpose, it should be possible to introduce appropriate types of seed drills in different regions and train local artisans to manufacture and popularise them in areas where they are not in use at present.

Agricultural universities should also undertake research to improve these drills. Suggestions from local artisans and farmers may be invited and incentive awards also given for the purpose.

10.5.8 Transplanting of paddy is a very arduous and time-consuming operation. A paddy transplanter, designed by a Gramsevak in Orissa, has been introduced in paddy areas recently. The implement works satisfactorily and deserves serious trial and further improvement to make it acceptable in all paddy growing areas. Use of implements for intercultivation should be popularised along with drill sowing or dibbling for weed removal. Further research to improve the indigenous hoe, commonly in use in the country, would also be necessary.

10.5.9 Harvesting, threshing and winnowing operations, if done properly, reduce harvesting losses and improve the quality of the produce. In India the crops are harvested in different ways and there is no special indigenous implement for harvesting any crop nor any attempt has been made to bring about improvements in harvesting operations. The various kinds of threshers being used in the country also need to be improved. In this context, the Japanese model pedal-operated thresher requires to be improved for general acceptance. For separating grain from chaff, the threshed material has to be winnowed. The traditional dependence on wind, is slowly giving way to different kinds of implements. In recent years the engine operated stationary thresher-cum-winnowers are becoming popular. Every village should be provided with the stationary thresher-cum-winnower on custom service basis to meet the full needs. Attempts should also be made to devise simple reapers for harvesting various crops. Particular attention is required for developing harvesting machines for crops like groundnut, cotton and potato.

10.5.10 In the previous section, complete mechanisation of water lifting has been suggested. But where only a small quantity of water is available and lifting need be done through a few feet only, heavy investment on mechanisation may not be worthwhile. It would, therefore, be necessary to continue research work to develop simple bullock or hand operated devices, which give increased mechanical advantage over the existing indigenous types.

10.5.11 Apart from the implements mentioned above, the farm has to be equipped with other appliances like seed drum, sugarcane crushers, chaff cutters, etc. In this context, one or two seed treating drums in each village may be provided. Special efforts should be made to popularise chaff cutters throughout the country so that every farmers may possess one of suitable size in order to reduce wastage of fodder.

10.5.12 Hand tools like sickle, pickaxe, spade, *khurpi* etc., at present in use, are made of scrap metal and often ineffective. There is ample scope for bringing about improvements in design and quality of metal used, for which intensive research should be carried out. These improved tools of standardised shapes should be made available locally at low price. For producing them, steel of desired quality should be made available at fair price to the production centres through steel banks which should be set up specially for the purpose. Manufacture of such standard tools may be taken up at the taluk or district or State level through farmers' cooperatives or agroindustries corporations. Local artisans can profitably be trained for this purpose, though it would be better if they are adequately trained more in repair work rather than in manufacturing. Such training could be imparted through activating and establishing more Gramsevak training centres.

10.5.13 The research workers in India should keep the findings of the team of specialists from Michigan State University (USA) regarding the mechanisation of agriculture in equatorial Africa in view, while carrying out improvements in tools and implements. Another important aspect that requires special consideration is the development of a standard multipurpose tool-bar, which could be used with various bullock drawn implements. The general objective should be to develop implements and machinery that are easy to work with and are conducive towards raising productivity. Village artisans can contribute a lot in making suggestions for developing better designs. Incentives may be offered to them by way of prizes, and wide publicity given to such a programme.

10.5.14 The bullock cart would continue to play a prominent role in the transport of agricultural commodities for a long time to come. They are still old fashioned and need improvement. Standardisation of the size of the cart wheel so as to facilitate large scale manufacture of tyres of either solid rubber or pneumatic type would be essential. The agroindustries corporations should undertake the manufacture of such improved bullock carts. Attention will also have to be given towards designing yokes suitable for use by cross-bred draft animals as future emphasis is likely to be more on cross-breeding.

Inanimate Power Operated Implements and Machinery

10.5.15 In the field of mechanical and electrical power, it is the tractor which is the most versatile in farming operations. With its introduction as mobile power, many kinds of matching implements

and machinery have been introduced in the country. Some are being manufactured in the country. But these are of the same type as the ones introduced from outside along with the tractors. Intensive research to improve the designs to suit varying soil complexes of the country will have to be carried out at different places.

10.5.16 Too much dependence on imported foreign machinery to develop prototypes is not desirable. There is need to develop expertise capable of designing and fabricating machinery suited to the country's needs. The entire research work should, therefore, be systematised and the development of prototypes of implements and machinery and their feasibility trials before release to the prospective manufacturers should be incorporated in the research programme compulsorily. The institutions, which have to be involved in such research work, are the Central Institutes of Technology and Agricultural Universities. All these institutions must have ample workshops facilities, and it is imperative that they must be provided with adequate funds. These research institutions should associate farmers, extension workers as well as manufacturers so as to elicit their views on the prototypes developed by them. Mass scale manufacture should not be permitted without the feasibility trials.

10.5.17 The RTTCs must also be strengthened with more capital investment to enable them to undertake research on implements and machinery. These centres must be brought under one or the other agricultural university in order to ensure a uniform pattern throughout the country, but their individuality should not be destroyed and the funds allotted to them should be expended on them only.

Manufacture, Quality Control, Supply and Service

10.5.18 The existing capacity in small, medium and large scale sectors will be sufficient to cope up with the demand for implements and machinery. Though no new capacity need be created at present, the position may be reviewed after a few years. There is awareness about the requirement of the manufacturing industry with regard to the various kinds of implements. What remains to be looked into is the quality of implements and machines produced and their ready availability to farmers. It is also necessary to have adequate arrangements for their repair and maintenance.

10.5.19 For controlling quality, the ISI standards should be made applicable to all manufacturers in any sector—small, medium or large. The village artisans should also be made familiar with these standards relevant to their profession and their products must be tested by the agroindustries corporations. The implements manufactured by

medium and large sector undertakings should be tested by RTTCs. In the case of big manufacturers, each machine sold by them must have a performance report. Also there should be some uniform standards for testing and evaluation of farm implements throughout the country. The manufacturers should have proper market intelligence data relating to agricultural implements and machinery, which the State Departments of Agriculture should undertake to collect. The maintenance and repair of these implements should principally be undertaken by the agroindustries corporations in their workshops while also encouraging private parties to undertake such services.

RESEARCH EDUCATION AND EXTENSION

1 RESEARCH

11.1.1 One of the goals in agriculture is higher and more improved and diversified production. In order to achieve this a multi-disciplinary approach to the application of science and technology in the development of agriculture is necessary. Science cannot be applied to solve problems of food, etc. without bringing the related disciplines together. Just as a single discipline may have a variety of applications in multiplicity of programmes, so does a single programme involve multiplicity of scientific disciplines for its successful culmination. In fact, agriculture is intrinsically amenable to such an approach.

Categories of Research

11.1.2 There are three categories of research, namely, fundamental, applied and adaptive. The definition of each of these categories and their respective scope have been discussed in the Commission's Interim Report on Some Aspects of Agricultural Research, Extension and Training (SAARET) and the responsibilities amongst the various agencies engaged in research demarcated in order to derive optimum benefits from the total research programmes. The responsibility of research and development in agriculture lies mainly with the agricultural universities, Central research institutes of the Indian Council of Agricultural Research (ICAR) and the State Departments of Agriculture. The agricultural universities have generally not been able to undertake fundamental research so far even though endowed with the congenial academic climate to do so. In the interest of agriculture, it is essential that they should pay immediate attention to this aspect. The situation in this regard is similar in the ICAR research institutes, some of which, though well equipped, have yet to develop into excellent centres of fundamental research. There is, therefore, an urgent need to encourage development of specialised centres of fundamental research in different parts of the country which would be capable of tackling the problems which are basic in nature. The best places where such

centres could be developed are naturally universities in general and agricultural universities in particular. Central institutions of the ICAR are also places where such centres could be developed. One of the ways to encourage universities to develop such centres would be the setting up of professional chairs by the ICAR.

11.1.3 It is desirable that institutes for fundamental research are also the places for applied research because there is an essential need for a healthy symbiosis between the two. A university will need well-equipped farms in different climatic zones for the purpose of its applied research programmes. Some of the State regional research stations should, therefore, be placed at the disposal of the universities in such a manner that they have at least one station for each type of climatic regions. If any climatic region does not have a station, it is desirable to open a new one. While agricultural universities should be fully responsible for basic and applied research in agriculture, animal husbandry and related sciences, they must be given adequate facilities and funds for discharging their responsibilities as the scientific consultants and advisers to the Departments of Agriculture, Animal Husbandry, etc.

11.1.4 Adaptive research, i.e. the process of leading research to its production goal, which requires extensive experimentation in the choice of technology, is most competently carried out by the State Departments of Agriculture which have adequate resources and wide jurisdiction throughout the agroclimatic regions of their States. In doing so, State departments should confine themselves only to adaptive research such as varietal testing, fertiliser recommendation based on soil analysis, water duties etc, and must not use this freedom to develop parallel research organisations in competition with the universities. The objective should be to see that adaptive research carried out by the State departments is based on applied research work done in the universities and Central research institutes. To ensure this, there must be an Adaptive Research Council in Government departments similar to the Research Council obtaining in agricultural universities. In these councils the senior university experts should also find a place and their advice given full consideration in planning adaptive research programmes of the Government departments. In the past when the State departments were in full charge of research and education, a research worker was generally not involved in administrative or extension work. To make adaptive research meaningful, a system must be evolved in the State departments whereby research personnel also have the experience of administration and extension work so that they have the necessary field experience to back up their research. State experimental farms which are meant for demonstration work should be exclusively under

the control of the State departments for being utilised for adaptive research and extension work without precluding the agricultural universities from using them.

The Indian Council of Agricultural Research

11.1.5 The establishment of the Imperial Council of Agricultural Research in 1929, which was renamed as the Indian Council of Agricultural Research (ICAR) in 1947, was the most significant step in the field of agricultural research. Initially, the objectives of the ICAR required it to promote, guide and coordinate agricultural and veterinary research throughout the country without either maintaining research institutes directly under its control or employing its own expert staff for the purpose. In fact, the Royal Commission on Agriculture (RCA) did not envisage the establishment of research institutes under the control of the ICAR but had suggested the setting up of Central crop committees on the lines of the then existing Central Cotton Committee by providing a suitable linkage between the Council and the crop committees. This arrangement was found neither adequate nor efficient resulting in the neglect of research relating to soil, agronomy, genetics and breeding, plant pathology, plant biochemistry, etc. Considerable research material on crops and animals accumulated at the various Central and State research institutes and other organisations and university laboratories. But in terms of research results and their transfer from the laboratory to the field, much of them were of no practical value. Some State Governments did build up good research organisations of their own relevant to their needs. In other States research work was badly neglected.

11.1.6. The agricultural research situation in the country as a whole was thus far from satisfactory. A number of expert teams were, therefore, set up to review the various aspects of agricultural research, education, extension and administration to recommend ways and means of effecting improvement in research. The last of the review committees, the Agricultural Research Review Team (1964), recommended a complete reorganisation of the ICAR and an overhaul of agricultural education. A number of agricultural universities were set up in different States more or less on the pattern suggested by the ICAR. The ICAR itself was reorganised by the Government of India in 1966 by bringing under it all the research institutions under the control of the then Ministry of Food and Agriculture and by reconstituting the Governing Body of the ICAR to make it pre-eminently a body of scientists and others with knowledge and interest in agriculture. The Government also decided that financial assistance to research institutes

and universities would be made available by the ICAR in the form of block grants on the model of the Atomic Energy Commission. Recently, the ICAR has gone through some further organisational changes to make it more purposive. The ICAR Society has been made more compact and specifically related to its scientific and educational charter. It is also assisted by a large number of scientific panels representing various disciplines of agriculture, animal sciences, fisheries and social sciences. These panels are in general expected to review research work periodically; suggests measures for coordinating research activities; assess research schemes from the scientific, technical and technological angles and suggest priorities for research. A review of the activities of the scientific panels suggests that while some panels have taken pains to identify gaps and priorities of research, others have not applied their mind to the extent expected of them. The ICAR should ensure adequate follow-up and speedy implementation of the panels' suggestions. It should, with the help of its scientific panels, undertake to draw longterm plans of fundamental and applied research, identify gaps in information and assign them for execution to appropriate scientists, universities and research institutes. The scientific panels should receive adequate administrative support from the ICAR to enable them to deal with *ad hoc* research schemes more purposively. Completed items of research undertaken under the *ad hoc* schemes should be compiled suitably lest they should be lost sight of. Attempts should be made to sponsor a large number of research schemes on subjects which have so far received inadequate attention. The money available for *ad hoc* research schemes should be more and more diverted to universities and other research institutes wanting in research grants. The granting of *ad hoc* schemes to the ICAR research institutes should be discouraged.

11.1.7 Coordination among the research scientists working on related problems, whether belonging to the same or different disciplines, is regarded as essential for quick transference of the results of research to the field. In this overall coordination, the All-India Coordinated Research Projects occupy an important position.

11.1.8 In its Interim Report on Organisational Aspects of All India Coordinated Research Projects (AICRPs), the Commission has highlighted the lacunae in the working of these projects and suggested steps to remedy them. A fresh look is considered necessary with regard to these coordinated projects in respect of their criteria, location, funding, administration, evaluation and follow-up. With the extension of the coordinated research projects the number of *ad hoc* research schemes financed by the ICAR has been fewer with the result that the research activities in universities which are unable to finance

from their own resources are on a low key. It is, therefore, necessary that in spite of the increasing importance given to the coordinated research projects, the *ad hoc* research schemes coming specially from the universities are liberally funded.

11.1.9 The ICAR should concentrate more on problems of national importance and develop suitable coordinated programmes on research problems of both fundamental and applied nature. Some of these problems could be handled through all-India coordinated research projects with advantage. Such projects should broadly satisfy the following criteria :

- (i) the projects should envisage problem-oriented applied research of known knowledge under different broad agro-climatic conditions with marginal short-term basic research;
- (ii) the problems to be studied should be of national importance and they may belong to a single discipline or may be multi-disciplinary;
- (iii) problems should be such as to warrant the concentration of efforts of a number of scientists on a single problem; and
- (iv) the projects should aim at developing recommendations in the shortest time for increasing production.

But all the research programmes requiring multidisciplinary approach need not be covered under coordinated research projects. In such cases, where it is necessary to carry on research at more than one centre, a coordinated programme should be developed, through appropriate funding and necessary arrangements for coordination without the necessity of having a coordinated research project. These programmes should be divided between the agricultural universities and Central institutes depending on the nature of problems to be studied. In doing so, the ICAR should lay down the type of coordination suitable to the particular programmes under various schemes financed by it. All research work of local importance should be carried out by the agricultural universities and the State departments through their own organisations. There may be no need for the ICAR for making any institutional arrangements for coordination of such research work. It is noticed that where coordinated research centres have come up, existing State/university research centres have been closed down. This has to be discouraged. An important objective of these coordinated projects being to provide additionality and not to replace research efforts already in hand, the State Government should not reduce the allocation for research in their development plans. Further, under the coordinated projects there is no clear distinction as to the categories

of research conducted namely, basic, applied and adaptive. It is necessary to reiterate that only problem-oriented applied research of known knowledge along with marginal short-term basic research should be conducted in these projects. In other words, a very large part of research work in agriculture should be conducted outside the purview of the coordinated projects under the coordinated and individual programmes.

11.1.10 The ICAR administers and finances 28 research institutes; two more are contemplated during the Fifth Plan period. There is no denying the fact that the tempo of scientific activity throughout the country is high, and the total scientific output, enormous. Even then, everything is not well with the research institutes and a fresh look is needed in the matter of organisation of research not only in the institutes, but also in the ICAR itself.

11.1.11 Considerable differences are noticeable in the research institutes in the matter of staff and expenditure pattern, staff strength, annual expenditure per scientist and ratio of scientific staff to field and/or administrative staff. Some of the institutes are too big in staff and financial resources and some too small. There are institutes established for a single crop, species or commodity covering various aspects of the same species, e.g. rice, cotton, jute, sugarcane, tobacco, sheep, fruits, grass and fodder etc. Some of these species are also the subjects of coordinated research projects. There are some species like wheat, jowar, bajra, maize, pulses, oilseeds, cattle, poultry, etc. for which there are no specific research institutes as such but they are covered by coordinated research projects and projects of agricultural universities and of general agricultural research institutes. A study of the growth rates in production and productivity reveals that except for coffee and tea, none of the crops covered by research institutes shows any marked growth rates either in production or productivity. On the other hand, among crops not covered by any research institute maize and wheat show high growth rates. Thus, the absence of the expected impact of science and technology on production and productivity in those crops where research attention is being bestowed upon by a large number of competent scientists, working in well-equipped laboratories, needs thorough probing.

11.1.12 Except the Indian Agricultural Research Institute (IARI) whose research efforts are widely spread over almost all crops and all disciplines, each of the other institutes of the ICAR restricts its objectives either to one discipline or to one or a group of species i.e. crops and animals. While the breaking up of research work into disciplines and species is on the basis of need, convenience and expeditiousness, there is in fact no scope for dichotomy in respect of disciplines and

species because they are inter-related and can go together only when suitably balanced. The tendency of establishing divisions on the basis of a discipline and of expanding them by introducing limitless sections or units based on species has to be deprecated and stopped at an appropriate and manageable size of the divisions. Whether based on disciplines or species, the location of a research institute is usually decided upon by the contribution it can make towards the development of the discipline or species in the same and similar regions. If based on species, the institute should be located at a place representative of the appropriate agroclimatic conditions in which the species could flourish best. Research institutes should, therefore, be spread evenly over the different agroclimatic regions and for this purpose, they should preferably be of small and medium sizes having more specific and restricted objectives so that manageability and viability are assured.

11.1.13 The ICAR research institutes are subject to the usual constraints of Government departments arising from the centralisation of functions and have no autonomy in practice. The institutes are differentiated not only in terms of status but also by the extent of power delegated to the Directors. Even their scales of pay vary. Such discriminations and status distinctions are not proper and conducive to the growth of a healthy scientific community. It is strongly viewed that the posts of Directors of all the ICAR research institutes should carry the same scale of pay, the salary being fixed in accordance with the merits of the persons as a scientist.

11.1.14 Evaluation is indispensable for good management. The ICAR is getting the performance of each of the institutes assessed by Achievement Audit Committee set up once in every 5 years. The aim is to improve the working of the institutes on the basis of the suggestions and recommendations of the Committee. In practice, however, the ICAR did not follow-up the recommendations and allowed the whole exercise of the Achievement Audit Committee to become a futile ritual. To avoid such a situation and for the sake of better management of the institutes, the good institution of achievement audit committees should be taken seriously and the recommendation of the Committee followed up as effective instruments of improvement.

11.1.15 The concept of an integrated approach to research, teaching and extension education has been accepted as the keynote of agricultural universities. But the role of the ICAR institutes in respect of research, teaching/training and extension requires to be defined.

11.1.16 The ICAR institutes are all engaged in some kind of teaching/training and most of them are recognised as centres of research for doctoral work by one university or the other. A good

number of them propose to introduce post-graduate courses and are eager to convert themselves into degree awarding academic bodies. Now that universities have been established in good number, the training courses in research should be centred in the universities only. The present tendency of research institutes to compete with the universities in awarding degrees will defeat the very purpose of the institutes, and should be done away with.

11.1.17 The need for extension of research results for the benefit of farmers, industries and any other agency willing to take advantage of them having been recognised, each institute should have a liaison unit, not necessarily a division, to communicate with extension workers in the area through the State departments and publish bulletins, booklets, etc. as would be required to further the extension work. They may not themselves have anything to do with extension work in the field. The institutes should refrain from large scale production and distribution of material e.g. seeds (except breeders seed), fertilisers etc. but restrict themselves to researches on development and perfection of products allowing outside agencies, preferably trained persons from the institutes/universities to commercialise the products.

11.1.18 In each of ICAR institutes, the spirit of expansion permeates throughout. This should be checked. The institutes differ considerably in their scope and objective and hence in their size. A multidisciplinary research setup is characterised by a 'critical' number of scientists and amount of facilities. Below these critical values research effort is not likely to be viable, and above this limit difficult to manage. On considerations of viability and manageability, a research institute should not have more than eight divisions each of six sections. Each sections should be manned by not more than five researchers so that the total number of research staff of the institute does not exceed 240. Institutes of smaller size are more manageable and should not be allowed to expand beyond the suggested limits. Those institutes/divisions which are below the 'critical' size should be strengthened and those above should be allowed to be dispersed in the best possible manner, or redistributed with suitable administrative changes.

11.1.19 The Indian Veterinary Research Institute has developed into an institute of unmanageable size. Its further expansion would adversely affect the growth of animal health research which needs to be strengthened to support the massive livestock development projects being taken up using exotic germ plasm. In view of the need to develop animal genetics in an integrated manner it is essential to set up an Institute of Animal Genetics and Breeding. The institute may also deal with the discipline of animal reproduction. This along with

four other institutes, two existing and two proposed in chapter 7—one on poultry and the other on animal nutrition—should be able to cater to the needs of research work in the field animal sciences.

11.1.20 Research management requires specialised training which every Head of an institution should acquire. Facilities should, therefore, be created for management training of personnel engaged in agricultural research and technology. As regards the scientists at the ICAR headquarters, the principle of tenurial assignments should be rigidly followed and no one allowed to have more than two terms of three years each.

11.1.21 Each institute has its own way of identifying problems of research, but there is a more or less common procedure of sanctifying it at the level of Staff Research Council (SRC). While the problems of research should strictly be in keeping with the objectives of the research institution, the SRC is not effective in keeping a check due partly to its size and partly to the lack of interest of one department in the work of another and the lack of constructive, free and frank criticism. The attitude of multidisciplinary and interdisciplinary approach to the solution of problems has not sufficiently developed among the scientists. While the suggestion for reducing the size of the SRC to make it more active and effective is in the right direction, the SRC should encourage interdisciplinary research by sanctioning more funds for such projects.

Agricultural Universities and State Departments *vis à vis* Research Institutes

11.1.22 Since research is intimately connected with extension and field application, it requires a chain of authorities to transfer the research results to the field. There is enough scope for all the agencies involved—agricultural universities, the Central research institutes and the State Departments of Agriculture—to purposively serve the cause of agriculture in their own spheres of activities by collaborative and cooperative efforts for which suitable arrangements for coordination both at the policy making and implementation levels are necessary. It is this consideration which has made the Commission suggest a clear-cut delineation of responsibilities between the agricultural universities and State departments in the matter of undertaking the different categories of research. However, the attempt to deprive the State departments completely of agricultural research obligations has gone on unabated. But by impoverishing the State departments in respect of their research capabilities, the extension work would be further weakened affecting adversely the transfer of research results to the

field. In agricultural universities the emphasis is largely on applied research, the dearth of schemes on fundamental research pertaining to agriculture being conspicuous. This situation has arisen because of the indifferent attitude of the agricultural universities to basic sciences where the teaching of basic sciences is already poor. The problem of teaching basic sciences may be solved though not satisfactorily either by encouraging basic science teachers to undertake research on subjects bordering on agriculture or by giving special training to agricultural graduates showing proficiency in basic sciences. Even then, basic research would still go by default unless some radical changes are brought about in the entire research structure of agricultural universities and the research institutes. Centres of fundamental research must be developed in the agricultural universities. They should take up more and more of basic research related to agriculture and formulate such projects as part of their own research programme. The universities should not dissipate their resources and talents in undertaking extension work but leave adaptive research followed by extension on a large scale in charge of the State Departments of Agriculture.

Research Organisations other than Agricultural Universities and ICAR Institutes.

11.1.23 Before the agricultural universities came into being individual scientists in general universities undertook research work on problems basic to agriculture with the help of *ad hoc* grants made available by the ICAR, Council of Scientific and Industrial Research (CSIR) or the University Grants Commission (UGC). Except in a small number of cases, continuity of research has not been maintained because of uncertainty of such *ad hoc* grants. Even then, the scientific contributions of these *ad hoc* schemes may not be inconsiderable, and by widely distributing these schemes, an infrastructure of research personnel has been created throughout the country. It may be worthwhile to follow up the research contributions of these *ad hoc* schemes in a suitable manner.

11.1.24 The production, improvement and marketing of the four plantation crops, namely, rubber, coffee, tea and cardamom are managed by their respective boards. The research set up of rubber and coffee boards and that is of rubber and coffee research institutes is more or less on the same pattern as any of the ICAR or CSIR institutes. Judged by their overall performance, the research institutes of the rubber and coffee boards appear to be fairly efficient. The research climate, will, however, be more conducive if the research set-up is free from bureaucratic formalities. The rubber and coffee research institutes now under Ministry of Commerce should be handed over to the ICAR. The Tea Board has benefited from its own sponsored

research work as well as from those done by other institutions. Cardamom production is handicapped by lack of any research support. The coordinated project of ICAR on spices and cashewnut should pay special attention to cardamom.

11.1.25 The collaboration with international research organisations has taken the form of training and supply of research materials, financial and technical assistance for specific purposes or more elaborate involvement and responsibility of India. The only example of the last form is the International Crop Research Institute for Semi-Arid Tropics (ICRISAT). Though scientific and technical collaboration is an accepted principle, an underdeveloped country stands to lose in the long run. Complacency prevails because of ready help, which cuts at the root of self-reliance. The opposite has also happened though rarely. Because of these possibilities, all collaboration should be sought with proper caution and foresight.

Research Administration

11.1.26 Management of scientific and technological research plays a pivotal role in the application of results of research for development. The administration of agricultural research is to develop and maintain a research environment attractive to talented scientists and conducive to creativity. The important aspects to be considered in management are : (a) research planning and programming; (b) personnel policy; (c) organisational structure; (d) financing and budgetary system; (e) infrastructure; and (f) relationship with administrative authorities.

11.1.27 The research agency should gear its objective to the development plans and programmes and translate the national objectives into scientific and technological workplans and implement them effectively. To do so, all the scientists of a laboratory should be familiar with the agencies as well as the nation's scientific and technological objectives and country's socio-economic plans. They should be apprised of the functions of the laboratory in furthering these objectives. Each scientist would be required to submit annual as well as perspective plans at the beginning of each five year Plan for consideration of the laboratory council. Once the projects are distributed and budgetary allocations made for each project, the scientist-in-charge should be independent of any financial control within the budgetary allocation but accountable for the progress achieved and expenditure involved.

11.1.28 The personnel policy should be free from rigidity and instead of a hierachial system with defined functions and status and seniority consciousness, a collegiate system with appropriate freedom,

responsibility and accountability is desirable. Status and managerial position should be delinked from the scale of pay or salary. There should not be any bar in an outstanding scientist getting a higher emolument, even higher than that of the Head of the Department or the Director. Gradation of scientists into categories of A to F, as in the CSIR, with overlapping scales of pay commends itself.

11.1.29 The work of a research scientist should be appraised based on his self-assessment report. This procedure, which is more objective, should be given a fair trial. In the interest of the laboratory its scientists should be given opportunities to upgrade their knowledge by occasional training in advanced centres and attending and participating in conferences, seminars and symposia. Competent scientists should be allowed to accept assignments of study and research work on sabbatical leave and encouraged to write monographs, reviews and text books. For promising and brilliant scientists involvement in administration should be minimal. There should be arrangements to rotate administrative posts so that after a lapse of 3 to 5 years a scientist may return to his research work. The Director and divisional/departmental heads may have the option to step out at the end of a tenure if they choose to join the rank of active scientists. Further decentralisation and delegation of power at suitable levels would greatly aid autonomous functions. Delegation of power from the headquarters of the agency to the Director of the laboratory and a similar delegation to the head of a division/section are, therefore, desirable features in a collegiate type of structure.

11.1.30 The intricacies of budgetary and financing process has remained but there is ample scope for simplifying budget preparation. Another drawback is its annual character, which restricts long term planning of research projects. At least a block grant or a rolling budget on a five years basis may be quite helpful so that unspent money in one year can be carried over to the next. The control of expenditure of sanctioned budget for the laboratory should be entirely in the hands of the Director and similarly for divisions and even projects, in the hands of the heads and project leaders respectively.

11.1.31 Research is becoming increasingly dependent on sophisticated and costly equipment, most of which is imported. Maintenance of many of these equipments, which are not normally tropicalised, is costly. To economise on equipment and to promote its more efficient utilisation, the system of pooling of equipment in a laboratory is worth consideration. At no stage of training are scientists exposed to the discipline of the workshop. It is, therefore, necessary that every teaching institution and research institute should be provided with workshop training and the practice of designing and fabricating equip-

ment. The training besides being useful to a scientist may inspire him in a well equipped workshop to take to designing and fabricating equipment for his own research work and thus make him self-reliant.

11.1.32 The research organisations are autonomous only in name being subject to Governmental controls and rules and regulations and having no influence on decision making at the Governmental level. This problem has since been taken care of by the research agencies becoming departments in the relevant ministries headed by scientist-Secretaries. But at the laboratory level, the collaborative efforts should be close and cut across official redtape for the success of multidisciplinary research. There should be arrangements for the scientists belonging to the same or different agencies to exchange ideas, expertise and facilities and for scientists of one agency to work in another agency to derive mutual benefit. It should be seen that man capable of contributing to fundamental knowledge are given opportunity and freedom. All research originating in the minds of scientists should form an equally important component of the total research effort.

11.1.33 Research is considered prestigious and as a result, extension has been left to the less enterprising scientists with disastrous consequences. Extension work will suffer unless on the one hand, the status and prestige of extension workers are raised and on the other, the research worker goes to the field and joins hand with the extension workers to see that the research findings are properly applied.

11.1.34 The Government of India has reorganised the ICAR conferring on it a greater autonomy and flexibility in its operational and management procedures. A Department of Agricultural Research and Education (DARE) has been established in the Ministry of Agriculture and Irrigation to provide the ICAR with the requisite linkages with the Centre and State Governments and to deal with administrative aspects and international collaboration in agricultural research and education. The Director General of ICAR is concurrently the Secretary to the Government in DARE. There is complete integration of administrative and technical wings of both DARE and ICAR.

11.1.35 The ICAR has constituted a cadre of Agricultural Research Service for the optimum utilisation of available scientific manpower and for enabling the desired mobility of scientists, from one position to another, from one institute to another and from one region to another as may be required in the interest of agricultural research and education. For the initial induction the candidates for Agricultural Research Service should possess research experience and evidence of research capability. To attain this competence they would require at least 4 to 5 years after the Master's degree. It is, therefore, necessary to raise the maximum age of the candidates to 28 years. The

impact of this innovation on the quality of research output should be watched and evaluated over a period of time before any further changes are introduced.

11.1.36 In the matter of research funding, the research council of the agricultural university and the adaptive research council of the State Government should identify the priority areas of basic and long term applied researches which are of importance to the development of agriculture in the State and draw up relevant projects and programmes. The latter being of direct significance in agricultural development of the State, the State Governments should finance them entirely. The two councils should jointly decide upon the more essential programmes and projects and allocate funds accordingly in case of financial constraints. Considering the fact that the research base of agricultural universities is extremely weak, the Central Government should liberally fund research work in agricultural universities, not *pro rata* but rather on the basis of need to enable them to come up to a desired level. For each plan period the Centre and the States should inform the universities of the minimum level of funding for research from plan funds annually enabling the universities to plan the recruitment of at least 80 per cent of the research personnel on a fairly long term basis.

11.1.37 Research and development funding in agriculture is at present inadequate. This should be raised in a phased manner in such a way that in the course of 10 years it constitutes about one per cent of the contribution which the agricultural sector makes to the Gross National Product.

Some Topics for Research

11.1.38 Low productivity is a general phenomenon whether in crops, animals, fisheries or forestry. Emphasis should, therefore, be on research which leads to high productivity. The future research efforts should be directed more specifically to :

- (i) varieties of improved crops requiring intermediate doses of inputs for optimisation of yield;
- (ii) dry farming based on optimum water use;
- (iii) pulses, oilseeds, coarse millets, fodder, medicinal plants, vegetables and fruits;
- (iv) balanced emphasis on animal production, animal health and animal products technology;
- (v) mixed farming and use of a suitable mix of animal and mechanical/electrical power, keeping small size of farms in view;

- (vi) development of intermediate technologies;
- (vii) area development programmes;
- (viii) nutrition *vis a vis* food habits;
- (ix) waste utilisation and recycling of wastes;
- (x) development of biodegradable plant protection chemicals based on plant products having pesticidal properties;
- (xi) microbiological synthesis of products as supplementary and complementary to chemical synthesis;
- (xii) increase in the efficiency of solar energy utilisation by means of photosynthetic process;
- (xiii) introduction of nitrogen fixing power into cereals through genetic manipulation and other means, and tissue culture;
- (xiv) study of monsoons; and
- (xv) study of plant roots and their functions.

2 EDUCATION

11.2.1 Education for agriculture broadly covers all formal education in the subject from the school to the university level and also informal and nonformal education meant for those who practise the avocation as well as for those who support it in various ways. Essentially, its worth has to be judged by its effectiveness as an instrument of national development. Its aim should be to foster a sense of enquiry in every recipient regarding problems of agriculture and a desire to solve them.

11.2.2 In the past, the stress has been more on the development of higher education than on the primary, secondary and non-degree programmes of education. Modern agriculture needs properly educated and trained technicians and skilled workers at the lower level. In addition, there is an urgent need to educate farmers to understand and practise the new agricultural techniques. In such a dynamic situation, the existing formal education system, which has certain limitations, will have to be supplemented or partly replaced by a nonformal education system at various levels to provide the missing links and to upgrade the knowledge and skills of all categories of persons, namely, school/college going youth, school/college dropouts, persons engaged in various professions and practising farmers. In fact, to accelerate the process of agricultural modernisation, the primary producers must be made literate and aware of the tremendous potentialities for increasing agricultural production through the application of science and technology to agriculture.

Primary and Secondary Level Education

11.2.3 With the development of the concept of basic education with its emphasis on concurrent training in a craft, agriculture was introduced as one of the primary crafts in junior and senior basic schools especially those located in rural areas. The Education Commission (1964-66) which studied the impact of the programme in all its aspects recommended that this kind of educational programme in the junior and senior basic schools should be discontinued and that instead all primary and secondary schools should give an agricultural orientation to their programmes of general education by suitably orienting the existing courses. This is reiterated. Accordingly, the textbooks on general science especially biological sciences should be written and the existing ones revised. Similarly, education in home science should form an integral part of general education for all children up to the middle stage. Such an orientation towards agriculture would help create awareness of the problems of farmers, to appreciate the skills needed in farming and the possibilities opened by up science and technology including those of self-employment.

Nondegree Education Programme

11.2.4 Only about 25 per cent of the youth who complete general education at high/higher secondary school levels find opportunities for higher education. Most of the remaining youngmen belong to the rural areas and have to depend on land and other rural occupations for their livelihood. But the present system of preuniversity education does not at all prepare them for the purpose. The best way to make up the deficiency would be to introduce non-degree education programmes under which the youth may be trained as skilled workers and technicians and made to develop proper understanding, knowledge, attitudes and skills to appreciate farming as a respectable and profitable vocation and a means for improved living. In practice, very little attention has so far been given to educate the technicians and skilled workers who are, in reality, intermediate level workers directly concerned with the application of new technologies into practice. There is, therefore, an urgent need for organising sound vocational and technical training in agriculture to these workers (men and women) through appropriate non-degree education programmes.

11.2.5 Vocational agricultural education as at present organised has failed to step up modernisation of agriculture because of the wrong choice of age group of students, course content and timing of training. Most of the institutions attempt to train literate rural youth in sci-

tiffic farming but sufficient practical bias to prepare the trainees as independent farm operators is lacking. The schools are not properly equipped and the staff provided are too inadequate and the teachers not properly trained to impart training in scientific agriculture. As a result, the rural youth coming out of these institutions either look for Government or semi-Government jobs in the rural areas or turn to urban employment which is considered more prestigious. Very few select farming as their first choice for a life-long vocation. Every effort should, therefore, be made to make farming socially more respectable and economically more attractive so that youngmen and women are drawn to farm life. The training programme should aim at gaining the confidence of the youth and imbibing the spirit of self-reliance in them. A lot would depend on the quality of staff and extent of facilities available. The schemes of vocational education should be available more easily to small and marginal farmers who are hard-pressed for land and require greater technological guidance to increase productivity of their farms. Some appropriate short duration courses may be introduced in the agricultural schools for the purpose.

11.2.6 The role of technicians, such as field level advisers, field assistants, farm managers, etc. who are middle level functionaries, is becoming more and more important in the changing agricultural system. They may preferably be trained in the agricultural polytechnics and not in the agricultural schools, which could not endow the trainees with the desired level of vocational competence. The agricultural polytechnic or Krishi Vigyan Kendra (KVK) the idea of which was given by the Education Commission and preferred by the ICAR, is meant to provide nonformal education and bring about transfer of technology through work experience but not intended to train job-seekers. The KVKs initially being developed at five selected centres are planned to be trainers' training centres at which teachers of 50 other KVKs to be set up thereafter, will be trained. While some of these KVKs may be associated with the research institutes for the sake of expediency, as a long term policy and KVKs for trainer's training should be attached only to the agricultural universities. Some of them may also be operated, in consultation with and with the approval of the State Government, by voluntary agencies known for public service. Each of the KVK should have academic freedom to develop its own programmes in conformity with the needs of the area in which it is situated. Evaluation should be a built-in component of the KVK to review, revise and improve the course in conformity with the need of the region, type of trainees and development programmes. In tribal areas having a large percentage of drop outs at the primary/

secondary levels, some programmes of nonformal vocational education suitable for tribal people should be formulated.

11.2.7 With a view to meeting the needs of development in agriculture and related activities, it is essential to have at least one KVK in each district by 1985 and at least three per district by 2000 AD. If any existing agricultural education institution has the potentiality, it should be developed into a KVK. For their success, the programmes of vocational agricultural education should be linked with developmental programmes and availability of job openings. Also, the learners attached to a production enterprise should be suitably remunerated. As a follow up of the training, the trainees not absorbed in jobs should be provided with loans, marketing, extension and farm input services as a step towards self-employment. Since vocational education is comparatively costly, the infrastructures of existing institutions should be utilised, as far as practicable, for the purpose. The teachers' training colleges lack the necessary orientation towards agriculture and the trainee teachers do not possess sufficient experience in farming. It is advisable to give preference to those who have graduated from polytechnics and vocational agricultural schools and have appreciable farm experience.

11.2.8 In all farm youth programmes the development of rural leadership should also be aimed at and encouraged. Also, there should be ample opportunity and provision for continuation and development in academic skills and aptitudes so that apart from ensuring a flow of skilled operatives for the agricultural services, the best and the most gifted students could continue their training at the higher level.

11.2.9 The purpose of vocational agricultural education would be best served if the successful trainees get opportunities to utilise their training for self-employment and also to help implementation of the on-going development programmes. Every effort should, therefore, be made to have proper coordination and integration between these and the vocational training programmes. Coordination of nondegree agricultural education programmes is best ensured by an apex body consisting of the representatives of the ICAR, Directorate of Extension, National Council of Educational Research and Training, Ministry of Education and Social Welfare, Ministry of Labour, Ministry of Health and Family Planning and selected technical heads of the State departments. The responsibility for follow-up activity, guiding, supporting and assisting the field activities in connection with youth programmes and developing nonformal educational activities at the block level should be that of the block authorities.

University Level Education

11.2.10 Higher agricultural education has to be concerned with the education of qualified men and women who would eventually occupy leading positions in scientific farming, shaping agricultural policy, agricultural research, in teaching, administration and also in industries based on agriculture. The concept of agricultural universities took gradual shape. Since 1960, when the first agricultural university was established in Uttar Pradesh, there has been a rapid growth of agricultural universities in the country, the number increasing to 21 in 1975. In spite of the fact that the agricultural universities were set up on a Model Act of the ICAR and with similar financial assistance, the rates of their development vary a great deal. In addition to agricultural universities, a number of research institutes under the control of the ICAR including the IARI, IVRI and NDRI impart university level education. Except the IARI, which is a 'deemed' university the rest have acquired recognition of one university or the other for their courses. Along with the growth of agricultural universities, there has been a rapid increase in the number of agricultural and veterinary colleges which are affiliated to or are constituent units of general universities. While the number of colleges has continued to increase, the intake of students in degree courses has declined after showing rapid increase until 1964-65. The intake in post-graduate courses did not show any decline. A few general universities also offer post-graduate programmes in biological sciences which have bearing on agriculture, such as agricultural botany, agricultural zoology, agricultural chemistry etc. Outside the agricultural universities, there are four schools of management conducting post graduate diploma training in business management and administration as applied to agriculture.

11.2.11 Though some of the universities have adopted the Model Act prepared by the ICAR in 1965-66 with slight variations, some others have introduced modifications in respect of a number of important provisions like those relating to research, extension education and affiliation of colleges. Since conditions differ from State to State it may be advisable to promote flexibility even within a State to try out different ideas and forms of management. Almost every State has one agricultural university and some States more than one. A few more States are thinking of having more than one agricultural university. Since the creation of more than one university is likely to complicate the relationship between the State departments and the agricultural universities in regard to allocation of funds and programmes of education, research and extension, there should be only one agricul-

tural university in a State having, if necessary, autonomous campuses in other suitable locations. Each such campus should have a Pro-Vice-Chancellor as its executive head, having the same powers in the campus as the Vice-Chancellor of the main university. All such campuses should be under one academic umbrella. To keep up the standard of agricultural education, sub-standard colleges should be abolished. In their place, the agricultural universities may have their campuses in suitable agroclimatic regions of the States as constituent units. The substandard colleges may be reorganised into KVKS or centres of vocational education.

11.2.12 In the universities, teaching, research and extension education should be integrated at the level of subject matter department/division enabling its head to utilise the capabilities of the staff to the best advantage. The position in this regard varies from university to university. Some have kept the teaching and research staff and their activities separate from each other. Some are still to structure their extension education activities. It is necessary that within the subject matter areas of the department, all the staff members engaged in research, teaching and extension education should be of equal rank and remain under the technical control of the head of the department, though for purposes of coordination, the Director of Research and Director of Extension might exercise their jurisdiction over their respective staff in the departments. To ensure this, the Dean of the Faculty/college who is incharge of teaching, the Director of Research and Director of Extension should be jointly responsible for an integrated functioning of the three activities within the overall purview of the subject matter areas represented by the college or the faculty.

11.2.13 The minimum academic programmes in an agricultural university should consist of : (a) crop production; (b) animal production; (c) veterinary sciences; (d) agricultural economics and social sciences; (e) agricultural engineering; (f) home science including nutrition; (g) natural sciences and humanities; (h) communication; and (i) agricultural meteorology. Specialisation should be introduced cautiously in relation to the stage of development of the agricultural economy and its employment potential. In the present stage of agricultural development in India, the major manpower need is for scientifically trained production-oriented graduates rather than for skilled specialists in the sciences at the bachelors' degree level. Such specialisation should be undertaken at the postgraduate level. The undergraduate curricula should aim at high level education and be developed with a core component emphasising fundamental principles with ability to solve problems as they arise and with electives in production oriented areas like crop production, farm management, farm

machinery and power, soil and water conservation, agricultural communication etc. Where opportunities for employment exist, undergraduate programmes in horticulture, animal husbandry, forestry, fisheries and teacher's training in agriculture may be taken up after developing suitable facilities. The emphasis in undergraduate programmes should primarily be on production or husbandry or management, extension, supply and services. For this, it is necessary to link teaching with actual farming practices. Every campus should provide through well-managed farms and production-oriented enterprises for different types of work experience for students 'to learn by doing'. The practical training required for either self-employment or professional employment should be built into the course except in cases like animal sciences and fisheries, instead of prolonging the training period of under graduates as it happens in internship training.

11.2.14 The universities should strengthen and improve the programme for bachelor's degree in agriculture, agricultural engineering and home science, keeping in view the need to impart production orientation to the graduate courses. A minimum amount of animal science courses should also be available to students of agriculture. Similarly, animal production and veterinary sciences should have a minimum number of courses in human nutrition. Where a good base in home science extension work in rural areas has been established by the agricultural university, a bachelor's degree programme in home science may be started.

11.2.15 Education of women has received scant attention in the agricultural education system. The home science programmes in agricultural universities should direct greater attention to the training of women. They should be trained for employment in extension work, community development, processing industries, administration, nutrition and home economics, research and teaching not only in home science and nutrition subjects but also in those related to crop and animal production.

11.2.16 Bachelor's degree programmes in basic sciences and humanities need not be started in agricultural universities. Post-graduate programmes in selected disciplines in basic sciences which would provide the necessary support to advanced research work in agriculture may be taken up.

11.2.17 Postgraduate training leading to M.Sc and Ph.D degrees should become a distinctive feature of the agricultural universities. While these courses are gradually withdrawn from the ICAR research institutes, as already recommended, the agricultural universities should diversify, strengthen and upgrade their M.Sc and Ph.D programmes in order to prevent the occurrence of any void. The agricultural services

in the State need professional people who have not only technical training in agriculture but also in project formulation, feasibility study and evaluation, farm planning, marketing and pre and post harvest technology etc. Suitable programmes for short term training should be arranged in the university so that students aspiring to have these specialised courses may avail of them.

11.2.18 Lack of suitable text books and basic teaching material is a serious impediment in raising the standards of agricultural education at the higher level. The staff of the universities including those of research and extension should accept, as a part of their academic responsibility, the preparation of suitable text books.

11.2.19 At present the Central and State Governments, the agricultural universities, the research institutes and educational and training institutions in the country are practically the sole employers of graduates and post graduates in different disciplines of agriculture. Employment in the private sector and self-employment are still nominal. The position is more or less similar in the case of veterinary graduates. The problem of unemployment among graduates, which became manifest from 1967 onwards, is the direct consequence of a decline in the intake by Government. It was accentuated by the rapid growth of agricultural universities and turn-out of graduates regardless of the demand in different disciplines and sectors. Among the other contributory causes were the limited budgetary and financial support by the State and Central Governments for jobs in the public sector, limited vision on the part of the agricultural graduates and lack of capital for self-employment.

11.2.20 Modernisation of agriculture through the application of science and technology has immense potential for additional employment of agricultural graduates and other trained technical personnel. Some of the promising fields for new employment are : (a) rural banking; (b) management of cooperatives; (c) supply and services of farm machinery and equipment; (d) supply and marketing of inputs; (e) food processing, preservation and marketing; and (f) KVKS/agricultural schools/farmers' training centres. To exploit the additional potential for the employment of trained personnel, the agricultural universities should : (a) review skills and training requirements for specific jobs, with the appropriate State departments; (b) work with the State Government in the drafting of development schemes; (c) develop placement services; (d) develop pre-service training; (e) develop refresher training when employers find that education is deficient; and (f) encourage self-employment training programmes. To ensure this, the ICAR should insist on the creation of an interuniversity task group which should study the employment opportunity of agricultural

graduates and formulate necessary action programmes. The agricultural universities should organise an efficient placement service to provide a link between the graduates and their prospective employer and where necessary, it would be desirable for the universities and employing agencies to confer regarding modification of courses or introduction of new ones keeping an eye on employment opportunities. They may also have short-term courses to meet the needs of employers.

11.2.21 As a body financing the agricultural universities and co-ordinating higher agricultural education and research programmes in the country, the ICAR should ensure that a group of universities together conduct postgraduate programmes for specialised areas on the basis of a system of transfer of academic credits from one university to the other so that duplication of costly efforts may be avoided. The agricultural universities have to develop linkages with the Departments of Agriculture, Animal Husbandry, Fisheries and other allied agencies in each State and should come to an understanding of each other's responsibilities in respect of some of the training programmes of State department officials and farmers on the lines recommended in the Interim Report on "SAARET".

11.2.22 The agricultural universities should develop close linkages not only with the ICAR and the State Governments but also with general universities, research institutions, manpower planning agencies and input industries. The agricultural universities and general universities could work for mutual benefit by collaborating with each other for improving the standard of postgraduate research. The universities and research institutes should come together in improving the standard of university education and in arming the State Government with adequately trained personnel for development work by formulating training programmes and implementing them jointly with a clear understanding of purpose and complementarity. The agricultural universities should work with the State manpower bodies as well as with manpower cells of private sector agencies so that manpower planning may be related both quantitatively and qualitatively to changing employment needs and opportunities. The university should also develop linkages with agencies which supply inputs to agriculture which would enable it to produce the technical manpower needs of these agencies, conduct inservice training for their staff and undertake collaborative research projects.

11.2.23 The ICAR and the State Governments should adequately fund the agricultural universities to enable them to carry out their obligations effectively. In doing so, rules and regulations should be simplified and operated with speed and efficiency. The universities should also by their projects and programmes attract financial support

from non-Governmental agencies and private foundations sponsoring research and development. It would not be proper, however, for the universities, in keeping with their tradition and legitimate function, to conduct any commercial enterprises for increasing their financial resources. For a well regulated flow of financial support to the agricultural universities, the State Government should fix block grants for a period of five years giving them complete freedom to regulate the expenditure within the grant without any precondition. An automatic annual increase of 5 to 10 per cent in the block grant should be allowed on the previous year's grant for normal rise in almost all the items of expenditure. The State Government should be prepared to give matching grant and to take over the entire liability of education and research programmes financed initially by the ICAR. Similarly, it should provide separate grants for the maintenance of physical assets created out of the ICAR financial assistance. Since there is generally a time lag in the release of funds by the State Governments or the ICAR on approved schemes, State Governments should provide sufficient "foundation" grants to the agricultural universities. Considering the inadequacy of the existing provision, 10 to 20 per cent of the total State plan outlay under the agricultural development programmes should be earmarked for agricultural education and research. The pattern of ICAR's assistance to the agricultural universities should be according to the guidelines suggested by the Committee of Vice-Chancellors and subsequently examined by the ICAR's Norms and Accreditation Committee.

Preservice and Inservice Training

11.2.24 With the rapid development of science and technology improvement in the functional efficiency of the research, extension and administrative personnel participating in agricultural development programmes depends on a suitable built-in system for on-the-job training. But a sizeable number of Village Level Workers (VLW) have not received inservice training even once. There is also a long interval of 8 to 10 years before these functionaries are recalled for refresher training. The main reason is lack of adequate facilities and reluctance of the departments to spare their field workers in the absence of any trainee reserve.

11.2.25 A number of Gramsevika training centres have been closed down in some States; in some others, the number of operating centres has been reduced following the stoppage of recruitment of Gramsevikas. These centres are at present conducting mostly *ad hoc* training courses for associate women workers, farm women, rural girls and inservice

training for Gramsevikas and Mukhyasevikas. In many States, the training and field programmes of Gramsevikas and Mukhyasevikas are controlled by different departments with the result that there is no uniformity in the job charts of the Gramsevikas and hence in the training content. In view of the important role the rural women play in agriculture and home improvement, the services of Gramsevikas are very essential in communicating upto-date technical messages in these fields. It is a retrograde step that the State Governments are minimising the importance of this agency and are according a low priority to the women's programmes. For education and training of women, the educational infrastructure at the middle and lower levels should be developed. The women's training centres should be strengthened and those closed earlier revived, and brought under the proposed Department of Agriculture.

11.2.26 No systematic arrangement exists for the inservice training of other functionaries like agricultural Sub-Inspectors, Demonstrators, Fieldmen, etc. Since the number of VLWs (men and women) and other functionaries needed at the field level is very large, all the Gramsevak training centres and other training institutes should concurrently run inservice training courses for them. For this purpose, the training centres should be equipped with adequate number of qualified teachers with upto-date teaching materials. Since modern farming involves managerial skills for efficient use of land, labour, water and other necessary inputs, a farm management specialist should be posted at each Gramsevak/Gramsevika training centre. To impart adequate practical training to VLWs, each Gramsevak training centre should be allotted not less than 20 ha of land with reasonable irrigation facilities. Necessary steps should, therefore, be taken to provide these facilities at centres where they do not exist. Where new centres are to be set up, it would be desirable to locate them at the available seed farms.

11.2.27 Three extension education institutes have been set up to provide a two-month training course in extension methods and techniques of communication to the instructors of Gramsevak training centres/Gramsevika training centres/farmers training centres and agricultural schools, Extension Officers and other functionaries directly engaged in agricultural production programmes. So far, not more than 50 per cent of the instructional staff of the Gramsevak and Gramsevika training centres, currently in position, have had the benefit of this training. It would be desirable if each State Government could draw up a phased programme of deputation of its staff for this training. The agricultural university should be suitably involved in this programme either by arranging classes for the trainees or by sending university experts on short-term deputation to the training centres. A joint training

board on which the relevant training institutions, faculties of universities and State Departments are represented should formulate training programmes, organise curricula and courses and set norms of evaluation of the trainees. The responsibility for training the trainers should be assigned to the agricultural universities.

11.2.28 The Extension Officers and others of equivalent rank at the block level need to be apprised of the latest technological developments and should also have a fairly broad based knowledge of personnel management, preparation of schemes, planning of programmes, budget preparation etc. A refresher training course of one to two months' duration for Extension Officers is being operated at selected agricultural colleges but the number trained seems to be small compared to the large number of officers in position. Moreover, the programme does not cover functionaries other than Extension Officers at the block level. Insofar as Extension Officers are expected to provide specialised guidance to the VLWs and the farmers on various production programmes, the inservice training to these and similar other functionaries assumes considerable importance. Considering that the inservice training of Extension Officers is being repeated after every three years, to keep pace with modern technology, it is imperative that all the agricultural universities and colleges should develop appropriate training facilities for officers of all categories.

11.2.29 The ICAR is organising summer institutes in agriculture since 1967 in collaboration with agricultural universities and other institutions for instructional staff of colleges and for scientists working at the research institutes, experimental farms and research stations. There is need to review the working of summer institutes to find out to what extent the benefits are commensurate with the financial commitments involved.

11.2.30 In organising inservice training programmes for the administrative personnel at the State level, the responsibility should be divided between the Central and State Governments, agricultural universities and the proposed Institute of Agricultural Administration and Management (Chapter 14). As recommended in the Interim Report on SAARET, a joint training board may be constituted at the State level, with a Joint Director as its convenor, to formulate a personnel training programme for the State as a whole. Under this arrangement, the agricultural universities should organise periodical training of top and middle level administrators and experts of Government departments. The State departments should arrange for the training of their lower level experts and administrators, and junior staff members at the field level including the routine training of field workers and farmers.

Education and Training in Animal Science*

11.2.31 One of the essential pre-requisites to improve livestock by the application of science and technology is the creation of a sound and efficient system of education in animal science. Alongside the provision of facilities for such education, it is necessary to ensure that knowledge and research experience gained in the class room, laboratory, farm, plant or clinic get scope for application so that the investment made in creating the facilities is fully utilised.

11.2.32 The development of animal science education in India had its beginning only in veterinary science when a veterinary school was opened at Poona in 1862 followed by a veterinary college at Lahore (Pakistan) in 1882. A civil veterinary department was established in 1891 and with its expansion more veterinary colleges came into being. A formal beginning of education in dairying was made in the country in 1923 when the then Imperial Institute of Animal Husbandry and Dairying at Bangalore started offering a two-year Indian Diploma in Dairying (IDD) on the lines of the National Dairy Diploma awarded by the Royal Agricultural Society in the UK.

11.2.33 Within a short period after Independence, there has been a rapid growth in university level education in veterinary sciences and dairying. More veterinary colleges have been set up and made constituent units of agricultural universities as they came into being. Apart from degree level education, they are offering Master's degree courses except one and the majority are imparting doctoral degree level education. With the responsibility of livestock development devolving on the veterinary departments, a composite course of training in animal production and veterinary science was introduced within the existing course structure. Similarly, dairy development received considerable attention after Independence and with it, the facilities for education in dairying were expanded and bachelor's degree level education introduced. Along with the IDD course, the bachelor's degree course in dairying was divided into two categories, viz., dairy technology and dairy husbandry. Facilities were also developed for regular postgraduate training and degree in dairying as well as for doctoral degree and post doctoral research work with scope for specialisation in a number of subjects.

11.2.34 The introduction of the composite course in veterinary science and animal husbandry without increase in the period of study

* The term 'animal science' here denotes the composite discipline having three broad divisions, viz., (a) veterinary science, (b) animal production, and (c) animal products technology.

beyond four years has done justice neither to veterinary nor to animal husbandry subjects. A number of review teams set up in the past had stressed that the programme of composite training in veterinary science and animal husbandry was not adequate and that there was need for greater specialisation with separate degrees being awarded for veterinary medicine and animal husbandry. The Second World Conference on Animal Production also emphasised the necessity of creating facilities for specialised training in animal production in the developing countries where animal production was lagging behind agriculture and animal health. Inspite of such advocacy, a well balanced and comprehensive educational system in animal science has not yet been developed in the country.

11.2.35 Animal production should be treated as an independent major subject. Both veterinary science and animal production should be developed simultaneously as separate subjects to high levels of excellence in order that they can contribute meaningfully to the development of livestock industry. The ICAR should, on a priority basis, initiate action for the introduction of a separate bachelor's degree programme in animal production in agricultural universities. Education in dairying should be integrated with the main stream of educational programmes in animal science and organised in agricultural universities. To make a beginning, agricultural universities located in States where dairying holds out promise of rapid development should take early action to organise dairying courses at bachelor's degree level. The Central Government should grant, through the ICAR, adequate financial assistance to selected agricultural universities agreeing to initiate such education programmes in dairying.

11.2.36 The bulk of the education programmes in dairying at present being implemented at the NDRI can basically be carried out in agricultural universities. These demand substantial time of the research staff and financial and other resources that could have been used with better advantage for research. The NDRI should primarily concentrate on researches in dairying of national importance, and divest itself of the burden of teaching for the IDD and the bachelor's degree courses in dairying as soon as the agricultural universities initiate the reorganised educational programmes in animal science. The existing educational programmes in dairying includes training in dairy technology concerning milk and milk products. For better exploitation of different animal products, education not only in dairy technology but also in the technology of other animal products should be developed expeditiously.

11.2.37 The reorganised educational programmes in animal science integrating the courses of study in animal production, veterinary

science and animal products technology should be developed in agricultural universities under a single faculty. The advantage in having a single faculty lies in the fact that all the three divisions being parts of the composite discipline of animal science, teaching under one faculty would ensure better coordination and a more balanced and integrated development of animal science. In doing so, training courses in dairy production should be integrated with animal production but the animal products technology course should remain separate. In the reorganised educational system in animal science, bachelor's degree courses may initially be introduced in (a) veterinary science; (b) animal production; (c) dairy technology; (d) meat and poultry products technology; and (e) wool technology. The duration of study of these courses should be more than four years. In addition, internship or intensive practical training for a fixed period should be introduced. Students in animal production should be provided with a choice of elective subjects pertaining to a particular species of livestock. Such course may be pursued during the last six months of the study period. A thorough revision and recasting of curricula and syllabi will be required for introducing the reorganised educational programmes. The ICAR or the Association of Agricultural Universities should constitute a special committee for this purpose.

11.2.38 The Second Joint Indo-American Team advocated that facilities for postgraduate education in animal science might be created only at places where a strong research base had already developed and teachers and research workers of high merit are available. In actual practice, postgraduate teaching in animal science with corresponding graduate level programmes has been introduced in colleges, primarily engaged in teaching. Such programmes should not be taken up indiscriminately. The ICAR should, therefore, make a thorough and critical evaluation of the facilities for post-graduate education and training in animal science subjects developed so far in the universities and Central and State research organisations.

11.2.39 Considering the present situation of the educational programme in animal science, the Central research institutes should undertake only the education programme of a specialised nature that the agricultural universities or other teaching institutions are at present unable to manage effectively. These institutes should also start gradually withdrawing from the Master's degree level teaching programmes that have been developed in the agricultural universities and other teaching institutions. Postgraduate certificates and diploma course should also be discontinued in the Central research institutes where such programmes or degree courses in cognate subjects have been developed in other teaching institutions. Eventually the teaching pro-

gramme in the Central research institutes should be kept limited only to doctoral degree level.

10.2.40 With the advent of agricultural universities lack of understanding has developed between them and several States resulting in disharmony in programmes of employment and training in animal sciences. It is, therefore, necessary to take effective measures to regulate enrolment and outturn of university graduates to match the demands of employment. In this connection the need for drawing up a memorandum of understanding between the agricultural universities and ICAR and also with State departments is keenly felt. The 'Apex Bodies', as recommended in the Interim Report on SAARET should be constituted in the States for overall responsibility for all round development of agriculture in the States.

11.2.41 Many training courses are at present being conducted in basic schools/multipurpose schools, rural institutes, agricultural colleges and other institutions maintained by different State departments, local bodies and private organisations. This is being done usually for meeting specific job requirements in agriculture or livestock industries. The entrance requirements and course content of these programmes need to be modified on the basis of periodical reviews by competent bodies. Provision of competent staff and teaching aids should be given adequate attention in these training programmes. There is need to establish intermediate level education programmes in all the three divisions of animal science with opening for subsequent university level education. Such a programme will benefit not only junior staff with below-university-level education and training but also other supporting staff with lower level and short-duration education and training whose services are essential for development work as well as in research and educational establishments.

Education and Training in Fisheries

10.2.42 Modern fishing industry needs a variety of skills, knowledge of complex technologies and familiarity with instruments. A change from the traditional to the scientific fishing industry, therefore, requires an educational system relevant and appropriate to the needs of the country.

10.2.43 A beginning in fisheries education and training in the country was made when a course of training in inland fisheries development and administration was started at the Central Inland Fisheries Research Institute (CIFRI) at Barrackpore in 1948 followed by a course in marine fisheries at the Central Marine Fisheries Research Institute (CMFRI) at Madras (later Mandapam) in 1950. A num-

ber of fisheries extension units were established by the Government of India for transmitting scientific information of practical value to fishermen and fish farmers. The training offered at these institutes had several shortcomings. Subsequently, at the instance of the Committee on Fisheries Education (1959) a Central Institute of Fisheries Education (CIFE) was established at Bombay in 1961 for imparting education and training in fisheries. For imparting instructions to marine fishing operative of all categories, a Central Institute of Fisheries Operatives (CIFO) was established at Cochin in 1963. In 1967, the Ministry of Agriculture established two regional training centres for inland fisheries operatives-one at Agra and the other at Hyderabad. With the transfer of the CIFRI from the Ministry of Agriculture to the ICAR the training course conducted at the Institute was taken over by the CIFE along with the two regional training centres at Agra and Hyderabad. Later, in 1973, a fisheries extension training centre was set up at Hyderabad for imparting training in extension methods and techniques to senior fisheries personnel.

11.2.44 The CIFE conducts a two years comprehensive course at the post-graduate level mainly for training District Fisheries Development Officers, covering all the aspects of marine and inland fisheries technology and administration. It does not claim to impart specialised knowledge but makes the trainees familiar with fishing technology, fish preservation and processing, marketing, business management, socio-economics, extension and administration. The CIFE has been recognised by the University of Bombay as a research centre for work leading to the Master's and Doctor's degree in zoology and bio-chemistry. The one year postgraduate course offered at the Inland Fisheries Training Unit, Barrackpore is meant for the training of fisheries personnel at the level of Assistant Fisheries Officers. Though restricted in scope, this course could not be very effective because of inadequate staff and facilities, particularly for field work. The CIFO trains personnel required to man the medium and distant water fishing vessels and also the supporting staff required by establishments ancillary to the fishing industry. The only other institute which imparts fisheries education leading to bachelor's and Master's degrees is the College of Fisheries at Mangalore of the University of Agricultural Sciences, Bangalore. The two-year bachelor's degree course offered at Mangalore is equivalent to a similar course of CIFE. The college has organised course in fisheries biology, marine biology, oceanography, fish culture and fish processing technology. Short-term courses in fish handling and freezing are offered at the Integrated Fisheries Project under the Ministry of Agriculture and Irrigation and the Central Institute of Fisheries Technology, Cochin (ICAR).

11.2.45 It thus emerges that in respect of fisheries education in India, an institutional structure for imparting instruction in fisheries at the postgraduate diploma and certificate levels has been built up. No worthwhile programme of fisheries education at the degree level has so far been taken up by the universities which could ensure appropriate standards of teaching and research on an all India basis. Research institutes in fisheries have at best organised some courses of training which are hardly adequate. The situation demands the strengthening and reorientation of the existing institutions so that they are able to cater to the needs of the country in regard to all the aspects of fisheries education. The CIFE should be suitably strengthened and expanded so that it could offer degree courses at the B.Sc and M.Sc levels. To facilitate this, the CIFE should be transferred to the ICAR. Similarly, the CIFO may also be strengthened with staff and facilities to make it more effective and useful.

11.2.46 As part of the agricultural education, fishery education should be imparted in the agricultural universities. But, keeping in view the special facilities needed for fisheries education, it would be wasteful for each and every agricultural university to have a fishery faculty. In fact, it is desirable to take advantage of facilities available at some of the general universities in the maritime region, e.g. Cochin and Bombay, for the purpose. The ICAR may select a few universities for supporting fisheries education, only agricultural universities for inland fisheries on a regional basis and the universities of Cochin and Bombay and the Mangalore College of the University of Agricultural Sciences, Hebbal for marine fisheries. Courses in fisheries at universities should be opened only after a careful examination by expert groups constituted by ICAR. The graduate level courses can be developed on a regional basis depending on the special needs of the region where a university is located but the postgraduate course should have an all India basis in order to provide for recruitment, placement and interchangeability of personnel at senior levels.

11.2.47 The B.Sc Degree course in fisheries should be of the same duration as other disciplines in agricultural universities and should be without any specialisation but with elective subjects such as fish culture, fish technology, fish processing, fish marketing, fisheries statistics etc., in the final year and additional practical training for six months after the completion of the degree course, preferably biased towards the elective subject. In the recruitment of middle level fisheries personnel, preference should be given to graduates in fisheries. The M.Sc Degree course in fisheries should cover, at an advanced level, all aspects of fisheries as included in B.Sc (Fisheries) but with specialisation in an elective subject. The duration should not be less than 2

years after the B.Sc degree. The admission should ordinarily be opened to the graduates in fisheries but those from other services should not be prevented from admission to M.Sc. course. However, an orientation course for such students in fisheries disciplines should be obligatory. In the recruitment of high level personnel and research associates in fisheries, preference should be given to candidates with M.Sc in fisheries.

11.2.48 The agricultural universities and such general universities as would have fisheries and allied courses should be the place for training research workers leading to Ph.D Degree in fisheries. Before the agricultural universities and some of the general universities in the maritime region start the B.Sc, M.Sc and Ph.D courses in fisheries, the university concerned or the ICAR should constitute a special committee to frame the syllabi and curricula to suit the special needs of the country in regard to fisheries education and research and look into the question of entrance requirement, core and elective subjects, duration of study, practical training, internship etc.

11.2.49 Extension services have an essential role in fisheries development. The training of middle level extension workers should receive special attention since extension has been a weak link in fisheries development activities. The extension centre in inland fish culture at Hyderabad should be suitably staffed and adequately equipped and the proposed extension centre in marine fisheries established immediately.

11.2.50 There are adequate facilities for the training of engineers in the basic subjects such as marine engineering, civil, electrical and mechanical engineering and in naval architecture in implementing several fisheries development programmes in the country. But there is a need for providing regular facilities at different fisheries institutions to orient these engineers suitably in the field of fisheries.

11.2.51 Provision should also be made for the inservice training of field assistants employed in fisheries research, production and utilisation centres at the secondary/polytechnic and the diploma/intermediate levels with opportunities to acquire higher qualifications at the degree level. Training for inland fisheries operatives has to be arranged at regional, and even at the State level so that instruction can be imparted in the local languages. Arrangements for this training should be made at the KVKS and other polytechnics at the State level for which adequate teaching staff and training facilities should be made available through the Department of Fisheries. Though with the establishment of the proposed Indian Institute for Agricultural Administration and Management some facilities for inservice training of management personnel at the higher level are expected to become available along with other disciplines, there would still be need for

organising massive technical training for these functionaries. This should be responsibility of the Central Government.

3 EXTENSION

11.3.1 Extension and extension education relate to the process of conveying the technology of scientific agriculture to the farmer in order to enable him to utilise the knowledge for better agriculture and a better economy. Agricultural extension service seeks to impart the necessary skills to the farmers for undertaking improved agricultural operations, to make available to them timely information on improved practices in an easily understandable form suited to their level of literacy and awareness, and to create in them a favourable attitude for innovation and change. Besides imparting knowledge and skills, another important objective of extension is to change the attitude and outlook of the farming community. In India, farms are generally small having little direct linkage with advancing agricultural technology. There is need for a massive education and extension effort to modernise the outlook of the common farmer and make him innovative, enterprising and willing to adapt readily to changing situations and new technology. Education of women in the farmers' households in agricultural innovations, subsidiary occupations and nutritional aspects should be an important part of the programme of farmer's education.

Demonstration

11.3.2 Demonstration is an important extension method in educating the farmer and occupies an important position in the country's extension programme. Demonstration work consists of three well defined stages, namely, (a) trial demonstrations or adaptive trials; (b) early or front line demonstrations; and (c) late or regular demonstrations. In recent years, with the introduction of the new technology in agriculture these stages of demonstration, particularly test demonstrations or adaptive trials, have not been followed, with the result that large scale introduction of new agricultural practices has been taken up without establishing a firm technological base for the innovation. A system had to be developed for maximising return with the new technology and impressing the farmers which required a package approach by the scientists. The need was to demonstrate the efficacy of new practices based on scientific knowledge, information and skill by bringing the scientist himself into direct contact with field problems and transfer the results of research quickly to the farmers. The National

Demonstration Programme has been taken up to fill the gap, though much more needs to be done in this direction.

11.3.3 The necessity of this type of demonstration became imperative with the introduction of the high yielding varieties which required entirely new agronomic techniques and a full package of practices. In such a situation the research scientists should themselves be able to demonstrate the high quality of techniques evolved by them on farmers' fields and test for themselves the validity of their recommendations. In the process, the specialists should maintain liaison between the research institutions and the extension agency and act as feeders both ways.

11.3.4 The objective of the National Demonstration Programme is to introduce the concept of productivity per unit area per unit time, the unit area being kept at one acre/hectare and unit time at one year. Its emphasis is on the optimisation of yields through multiple cropping. Its uniqueness lies in the fact that the demonstration is laid out by research workers providing opportunity to demonstrate on farmers' fields the capacity of science in transforming Indian agriculture. Thus, scientists have to demonstrate convincingly to farmers that the results which are obtained at research stations could be repeated on farmers' fields as well. In addition to their extension value, these demonstrations provide an active bridge between the research institutions and the farms, the farmers training centre and the extension agency.

11.3.5 These demonstrations have to be laid out by scientists who have specialised in agronomy, soil science, plant protection and water management. In actual practice, the demonstration work has been left to inexperienced and junior scientists defeating the very purpose of bringing scientists of proven ability close to the farmers and their problems. This necessitates an improvement in the operational procedure of the National Demonstration Programme. The staff located at each of the research stations of the agricultural universities should be encouraged to conduct the national demonstrations around research stations rather than establishing a separate team of national demonstration specialists in a few selected districts. The demonstration plot should be within the easy reach of farmers who are to benefit by them. In these demonstrations, sufficient attention has not been given to pulses, fodder, oilseeds and other commercial crops. There is need for taking up more of commercial crops in various rotations on demonstration plots so as to meet the needs of different categories of farmers. Since most of the demonstration plots are irrigated, there is need to make available to the farmers knowledge of water management technology through these demonstrations. Lack of facilities for soil analysis is another problem. Where facilities of mobile soil testing laborato-

ries are available, these should be fully utilised for the work of national demonstrations. Agricultural universities could arrange intensive refresher training programme for subject matter specialists in soil analysis so as to make them fully conversant with the latest research in techniques of soil testing. They should also be acquainted with the micronutrient deficiency symptoms in the crops. Field days, farmers' rallies, camps, training and publicity need to be organised on an accelerated scale to make these demonstrations fulfil their objectives. These demonstrations have so far covered only irrigated and assured rainfall areas. The research organisation and the technical experts under the State administration should develop suitable National Demonstration Programmes for new programmes such as dry farming, fodder development, horticulture and plantation crops.

11.3.6 Intensive livestock and poultry development programmes are being promoted on a large scale as a source of subsidiary occupation to a large majority of small and marginal farmers and agricultural labourers. These programmes are being supported by substantial investments in research and development for evolving and multiplying superior types of livestock including poultry. A massive infrastructural programme for effective health cover and for augmentation of feeds and fodder for the improved livestock is also being provided. Farmer's training and demonstrations in different aspects of animal husbandry are an important prerequisite for realising the economic and social objective of these programmes. With an intensive programme of cross breeding of local cattle with exotic dairy breeds, there would be need to educate farmers on the utility of crossbred bulls for draught. There should be suitable demonstrations on the proper use of the crossbred bullocks in different seasons and also on other animal husbandry activities such as, improved poultry raising, sheep rearing, swine husbandry etc. Similarly, in fisheries, national demonstrations will have to be developed. Since a substantial area of inland water and brackish water is controlled by State or by the State institutions, the demonstrations have to be developed mostly on Government or institution-owned farms as the pace-setter for intensive development of other water spreads in the surrounding areas.

11.3.7 In areas where there is paucity of water resources, irrigation losses have to be reduced to the minimum through proper water management so as to ensure irrigation at the crucial stages of plant growth. These aspects relating to the technology of water management should form part of the National Demonstration Programme.

11.3.8 Greater emphasis is needed on systematic test demonstrations or adaptive trials on farmers' fields in different areas recommended for trials. Active participation of at least a small number of pro-

gressive and intelligent farmers in each district will provide a regular forum for the scientific reporting of field trials in different areas. The work and experience in the national demonstrations should be evaluated continuously so that lessons of universal application are disseminated and there is an adequate feedback to agricultural universities and research stations for better organisation of these demonstrations.

11.3.9 It is desirable to have a large number of demonstrations to ensure positive results in changing people's minds. The emphasis should be on intrinsic motivational approach through education of farmers than on the extrinsic type of motivation which uses subsidies for demonstrations. Since acceptance of promotional programmes based on free supplies is negligible, greater attention should be given to increasing the achievement motivation of farmers by encouraging extension workers to organise village meetings and discuss the advantages of new practices. There should also be close coordination between extension efforts and availability of agri-support activities for the rapid transfer of agricultural technology.

Farm Information and Communication Support

11.3.10 Farm information and communication support is accepted as an essential component of agricultural extension programme for supporting the production activities of the farmers. The Central Information Unit of the Directorate of Extension of the Government of India and the Farm Information Units of the State Governments have been providing information and communication support by producing material for extension workers, instructional and research films, providing audiovisual aids for educating farmers and organising competitive shows. Agricultural universities have also established extension wings and communication centres. Some Central research institutes and public sector undertakings including industries have also been disseminating research and other information to a limited extent. There is need to bring about considerable amount of organisation and division of functions regarding the existing arrangements for farm information and communication which include publicity posters, visual demonstration of practices and instructions, supply of brochures and pamphlets on local problems, film and magic lantern shows, radio broadcast and television shows. These have to be linked up closely with the district extension organisation and not centralised either at Central or State level. It is necessary to ensure that the decisions regarding the form, time and method of dissemination through publicity media should be taken at the district level and made to suit the local condition.

11.3.11 The information organisation should have close rapport

with the research scientists so that the information to be supplied is in keeping with the latest research findings. Considerable streamlining has to be done at the Central and the State level in this regard. The Central Information Unit should only disseminate important scientific findings to the administrations in the States and leave it to them to disseminate what they think is topical and important from the local angle. Films should be topical and of immediate interest and should be properly dubbed in the local language. Films and magic lantern shows should be attuned to the local conditions and requirements. Studies about the efficacy of the radio broadcasting system and on the use of television as a medium of information should be carried out in order to improve them as powerful media of education. Very little use is being made of the local press in disseminating farm information. The State Departments and the agricultural universities should make greater use of local press for communicating farm information.

Farmers' Education and Training

11.3.12 The Farmers' Education and Training Programme is aimed at training farm leaders who would guide and influence fellow farmers in the villages in the adoption of improved technology. In actual practice, farm leaders do not necessarily pass on their knowledge to their neighbours and the required spread of technique and knowledge does not take place. It is necessary to ensure that after going back to their villages these farm leaders are involved in the extension process so that they may actively help the extension organisation in disseminating knowledge and in providing demonstration of higher technology. A suitable frame has to be developed to achieve this.

11.3.13 The farmers' training centres and Gramsevak training centres should, as far as possible, be located on the same campus and a senior officer should be incharge of coordinating the activities of these centres and the production programmes in the district. Due to financial constraints farmers are not receiving proper training in various aspects of livestock production practices. In the farmers training centres in districts where Intensive Cattle Development Projects and dairy schemes and poultry and sheep development projects are in operation, special facilities should be created to train farmers in these specific fields. There is also immediate need to train farmers and members of the farm families to improve competence in the profitable process of livestock products. Where fisheries are important, similar facilities have to be extended for training fishermen families as well.

11.3.14 The Farmers' Education and Training Programme should include the education of women in rural areas. A special curriculum

for women should be introduced for the more technical aspects of subsidiary occupations and to change the diet patterns and the production with a view to having better nutrition. A proper nutrition education will enable women to gradually change the existing pattern of diet and with it, the cropping pattern will also change. Farm women should receive appropriate nutrition education, since nutrition and health have a bearing on the size of the family. This aspect should find a place in the curricula of farmers' education. The present programme of training farm women should be expanded and intensified and a separate wing opened at the farmers' training centres with suitable staff for training farm women. The All India Radio has introduced in some States active women's programmes. It will be necessary to put across a special programme of broadcast for women emphasising action points in subsidiary occupations and nutritional guidance and culinary instructions. The *Mahila Samitis* organised under the applied nutrition programme can be suitably expanded to be the discussion forum for this special programme.

11.3.15 Illiteracy and low level of education of the farmers are a severe handicap in the modernisation of agriculture. The Extension Directorate at the Centre and the proposed Directorates of Extension at the State level should be more closely involved than at present in the administration of Farmers' Functional Literacy Programmes. Particular attention should be given to bring all those farmers, who cannot utilise the developmental facilities because of being illiterate within the fold of this programme. The farmers' training schemes should embrace the farmers at the lower socio-economic levels and the scope of farmers' training should be expanded to cater to the needs of different types of farming activities characteristics of a particular area.

11.3.16 Farmers' training is so far confined to selected areas only. This facility should steadily be extended to reach all the farmers as early as possible. The allotment of training centres should not be on the basis of districts but by the number of blocks taking into account the nature of the terrain and other relevant factors. For the present, there should be at least one farmers' training centre for every 15 blocks irrespective of the size of the district.

Extension Personnel and Professional Development

11.3.17 The VLWs and the Agricultural Extension Officers are at present the most important communication link between scientific agriculture and the farmer, taking a direct part in field demonstration and in the man to man communication and dialogue with the farmers. It is necessary to update their technical knowledge and have periodical

training in new methods and techniques of agriculture. They should be brought to the training centres at least once in three years for the purpose. The training should be problem-oriented and job-related covering all levels of personnel. The refresher courses for these personnel should be revised at an interval of two to five years depending on the field covered and the pace of advancement in that field. The training course should be of a short duration of six weeks or so.

11.3.18 The instructional staff of the various vocational training institutes may need a special course of subject matter training in order to orient them to the particular type of teaching which they have to undertake in their institutions. This training can be given in short courses by the agricultural universities. It is also desirable that some of the senior staff members of agricultural universities are deputed for the staff course organised on regional and all India basis. Similarly, the teachers in the agricultural polytechnics or Krishi Vigyan Kendras who should be graduates in the various disciplines, should be suitably trained in extension education.

Role of Various Agencies

11.3.19 The Extension Directorate in the Department of Agriculture of the Government of India acts in isolation. At the State level, the State Departments of Agriculture look after extension and training, though there is no organisation at that level to deal with extension and training in the field of animal husbandry, fisheries or forestry. In chapter 14, the strengthening of the Directorate of Extension at the Centre has been recommended enabling it to deal with national problems of training and extension more effectively. The training contents of home science do not match with the programme requirements, these being implemented in isolation. The section of Home Science and Nutrition Education in the Directorate of Extension, which has got the necessary orientation and capacity for coordinated approach should be suitably strengthened so that it can provide leadership at the national level. All such programmes as are being handled by other departments and ministries should be brought into its fold in the interest of better coordination. In extension or training, or training in non-degree vocational programmes or in home science, the problems are extremely regionalised. There should, therefore, be no control from the Centre in these fields. The Central unit should formulate broad national strategy and provide overall guidance. The responsibilities at each level should be clearly defined so that there is no overlapping of functions.

11.3.20 At present, agricultural extension is carried out by exten-

sion workers of various agencies i.e., the Community Development Block, extension staff under special programmes, farmers' training centres, national demonstrations and the agricultural universities. Every effort should be made to have proper coordination and integration between these agencies so that the farmer is able to take full advantage of them and multiplicity of agencies is avoided. The non-Governmental and Governmental undertakings like the National Seeds Corporation or the Fertiliser Corporation of India and similar other agencies like cooperatives should provide facilities for the training of farmers, farm youth and farm women.

11.3.21 In view of the valuable contribution which agricultural universities could make in improving the quality of training of VLWs a close relationship between the Gramsevak training centre and the agricultural university in the area should be established and maintained. The role of the agricultural universities in extension should, however, be confined to conducting field trials for testing the research findings, development of agricultural technology and demonstrating its practical utility, provision of farm advisory service up to the district level, functioning as a source of agricultural information, development of effective communication media, participation in training programmes etc. The Departments of Agriculture/Animal Husbandry/Fisheries at the State level should have overall responsibility for extension work and should also be responsible for suggesting field problems and formulating new farm technology, conducting field trials and demonstrations, running a common information cell along with the agricultural university, organisation of training programme etc. The Central Directorate of Extension will be responsible for coordinating extension and training activity in the country, and laying down broad principles for the nation in the field in consultation with the States. The Central agency should also conduct sample assessment of the extension and the training programmes with a view to drawing conclusions of value for improvement of these programmes. It should also maintain upto date data on man-power requirements in the context of development programmes.

12

SUPPORTING SERVICES AND INCENTIVES

1 CREDIT AND INCENTIVES

Evolution of Institutional Financing System

12.1.1 Efforts to build up the institutional financing system for agriculture commenced with the adoption of the Cooperative Credit Societies Act in 1904. However, during the first three decades of the century, the village moneylender remained the main source of agricultural finance. Various measures for debt relief and control of money-lending, including statutory reduction of amounts due, fixation of maximum rates of interest, protection of agriculturists and specified items of his property against legal proceedings, restrictions on mortgages etc., were undertaken.

12.1.2 Cooperatives were nurtured as the primary institutions to relieve farmers from the traditional burdens of debt and to promote thrift. They assumed an increasingly larger role in the agricultural sector both in the matter of quantitative expansion and diversity of functions, although credit continued to be their main function. The cooperative structure has undergone modifications at various stages of its growth. Not only did the number of societies expand, but also was there greater diversity in the functions assumed by them. However, in the system, credit societies predominated. The process of growth was facilitated by periodic reviews of progress at the expert level, revision of policies and procedures, legislative measures as well as financial, administrative and technical support by the Government.

12.1.3 Although the banking system also made certain pioneering efforts in the sphere of agricultural financing, the progress made in this regard was inadequate till the social control and nationalisation of banks in 1969. Since then the commercial banks have evinced growing interest in financing agriculture. They have experimented with a number of alternatives and combinations of methods and approaches in different parts of the country with varying degrees of success. These include building up of a base of field officers and extension officers, organising Agricultural Finance Corporation on a consortium basis for

project formulation and consultancy services on financing and implementation, developing expertise at head offices, group financing, adoption of villages, organising agricultural development branches, etc.

Achievements and Limitations

12.1.4 According to the National Credit Council, the credit agencies met only about 38 per cent of the estimated credit requirements for agriculture in 1967-68. There have been only marginal improvements in this position by 1973-74. As against the credit requirements of Rs 4,000 crores for that year, as estimated by the All India Rural Credit Review Committee, the institutional credit agencies provided Rs 1,537 crores (38.4 per cent) only, comprising Rs 919 crores (23 per cent) from the cooperatives and the balance (15.4 per cent) from the commercial banks. The two major systems have, therefore, to plan expansion of the lending capacity and performance on a much more ambitious scale and have to explore and adopt new strategies, linkages and methods so as to achieve a notable improvement in servicing this gap of over 60 per cent between the total requirements and availability of institutional credit.

12.1.5 The successive reviews of the working of the institutional credit system have revealed several lacuna in the procedure and organisation of the system in the country. Over large parts of the country small farmers have been handicapped for want of access to cooperative credit. An important feature of the cooperative credit has been its tendency to flow mainly to larger cultivators because of : (a) land ownership was the dominating criterion for admission of new members and extending credit; (b) cooperative leadership and management were mainly in the hands of bigger farmers; and (c) lack of technical expertise and operational efficiency inhibited the application of the principle of lending related to possible increase in income to a larger coverage of small farmers. Another disquieting feature of the cooperative system has been the rise in the overdues from year to year which affected its credit worthiness and also ability to extend further credit to the farmers.

12.1.6 Similarly, an analysis of the agricultural financing by the public sector banks as on March 30, 1973 has also revealed that the farmers having holding above 2.02 ha got about 74 per cent of the total credit advanced by the banks. The major factors which inhibited banks' efforts to cover small and marginal farmers more extensively were their organisational structure and conventional land based norm of security. No serious attempt has been made either by the commercial banks or the cooperatives to understand the special credit needs of the small farmers, let alone the marginal farmers or agricultural labourers, and develop the ability to attend to their needs. Conse-

quently, these sections of the farming community had a very niggardly share in the loans advanced by these institutions.

12.1.7 In order to enable these farmers to catch up with the previous lag, weightage has to be given in the credit system to their needs. Credit should be extended to them on preferential terms both in regard to interest charged and quantum of advances. This is necessary both on grounds of equity and optimum use of manpower and land. A comprehensive groundlevel organisations, fulfilling two criteria would be needed for the purpose. Firstly, it must facilitate the conversion of credit into inputs and services as well as the realisation of a fair price for the produce, and secondly it must operate fully on commercial basis covering all the needs of the farmers.

Major Components of New Credit Policy for Financing Agriculture

12.1.8 Efforts should be made to develop a total system of credit support to all activities facilitating modernisation of agriculture and rural development. The system should facilitate suitable linkages between finance and services for current inputs and capital investments in land development, major irrigation and farm equipment. The activities financed under the aegis should be actually or potentially viable from the financial angle. The institutional and public resources used for capital investment and working capital must generate, over a period, adequate income for repayment of loans. Where necessary, organisational support should be provided to generate financial viability.

12.1.9 The new institutional credit system should make it possible for the flow of credit and inputs to be equitably shared between the large and small farmers. To the extent that the availability of institutional credit is limited in relation to need, priority would have to be given to small farmers, since the large farmers have access to credit facilities on normal commercial terms from banks and also past surpluses lucratively deployed elsewhere.

12.1.10 There should be a single source of institutional credit for meeting all requirements of the farmers. There should also be a close integration of financing plans and lending between different agencies operating in an area in the form of agreed lending norms, broad division of functions and collaboration. Supply of credit should be integrated with the organisation and management of supply of inputs and services, and both these functions should be entrusted to a single agency at the field level.

12.1.11 In order to involve, to a greater degree, the commercial banks in agricultural financing, they should enjoy the same authority and facilities in terms of statutory rights over defaulting borrowers and

power to supervise and give directives to the borrowers for appropriate use of credit, as is the case with cooperative banks *vis-a-vis* the primary cooperatives. Commercial banks should be enabled to lend to small farmers up to 12 years when such lending is eligible for refinance from the Agricultural Refinance and Development Corporation or other financial institutions.

12.1.12 The credit system has to facilitate the adoption and spread of new cropping and tillage patterns, particularly in unirrigated areas. The adoption of new technology in rainfed areas, though leading to higher yields over a period of time, would not be able to avoid year-to-year fluctuations in production. It is, therefore, necessary to ensure that suspension of credit does not take place because of crop failures or market fluctuations. Adequate medium term carryover finances should be provided in dry farming areas to tide over the bad years. The criterion of profitability over a period of years should be built into the system of credit.

Organisation of Credit and Farmers' Service Societies

12.1.13 Keeping in view the above approach and objective of an efficient credit system for upgrading and modernising agriculture over the next ten years and facilitating the process of rural development in general, the Commission in its Interim Report on Credit Services has suggested the organisation of Farmers Service Societies (FSS)—one for each tehsil/block or any other viable unit of convenient size with as many branches as are required in the area—to provide an integrated agricultural credit service to the farmers. This service should be accessible to all small and marginal farmers and agricultural labourers, who want to upgrade their technology. In the implementation of this recommendation, problems have arisen requiring some modification of the original proposals within the basic concept and framework of FSS.

12.1.14 The FSS would be a registered cooperative body with a Board of Directors including 5 representatives of small farmers, 2 other members, 4 nominees of the Government, one of the financing bank and one Managing Director. The Board will lay down the broad policies, while their implementation and day to day administration will be the responsibility of the Managing Director who is to be appointed in consultation with and the concurrence of the financing bank.

12.1.15 The FSS should take care of all the development needs of the small and marginal farmers and agricultural labourers, village artisans and persons rendering rural services. It should not restrict itself to landbased cultivation only. Diversification of business is important and provision of facilities for developing subsidiary occupa-

tions like livestock rearing, dairying, fisheries, farm forestry, sericulture etc. should be encouraged to benefit directly the weaker sections of the farming community.

12.1.16 The FSS will derive its share capital from its members and the State Government. The working capital of the FSS should be drawn from the credit lines of the financing banks, sale proceeds and charges for services, reasonable trade margins inputs, commission and fees from marketing organisations margins on loans etc. They should develop close business relationship with other bodies such as land development banks and various corporations. Such institutions should play a vital supporting role in offering services to farmers to absorb credit for productive purposes.

12.1.17 There should be a union of FSSs at the district level for mutual consultation and coordination of policies. Where the production, marketing and processing of any agricultural produce assume large proportions in the district, a separate functional cooperative organisation should be established for each of such commodities. A close organisational and functional linkage should be established between the FSS and the functional cooperative organisations.

12.1.18 The State Governments and the cooperative departments should extend administrative and extension support to the FSS and direct and encourage them by way of quick registration. Close understanding with the promoters and the financing bank regarding nomination of the first Board of Directors and contribution of share capital, and bearing expenses on technical extension staff for the first three years would be necessary. There should be clear demarcation of functions between the extension services, general planning and development agencies and the FSS. Extension service should be the responsibility of the FSS in the areas served by it. The group of technical experts at the taluk/tehsil level should help the extension cadre of the FSS in technical matters. There would be no need for a separate departmental agency in these areas. The FSS should develop its own cadre with various hierachial tiers so that the right type of personnel get attracted for serving the society.

12.1.19 The credit needs of the FSSs for its activities regarding supply of inputs and services would be met by the financing bank, which will have a stake in their growth. The bank will prescribe the norms and procedures of financing by the FSS and will also have the authority to call for the accounts of the FSS at regular intervals. Besides, as the central authority concerned with agricultural credit, the Reserve Bank of India should take immediate steps for (a) evolving unified system of assistance to all institutional financing agencies for medium and long term credit so as to make commercial banks eligible

for such assistance as the cooperative banks; (b) assisting banks to formulate and implement a programme of selective launching and development of FSS; and (c) integrating the whole structure of agricultural financing from the ground level upwards right up to the creation of an Agricultural Development Bank of India as the apex organisation.

National Programme for Organisation of Farmer's Service Societies

12.1.20 The initial experience of launching new FSSs in pursuance of the Commission's Interim Report, though encouraging in several respects, has highlighted the need for greater care in the allocation of priorities for various activities of the FSS and their area of operation. It is also necessary that each FSS should formulate a strategy and decisions upon the content of extension services and use the extension personnel to the best advantage. Each FSS should be provided with the minimum equipment and facilities and its working entrusted to a compact team from the beginning.

12.1.21 For taking up the programme of FSS on a national scale, it is necessary to ensure that distortion of objectives do not take place while regional adaptations are made and the individual banks are not loaded with the heavy strain of organisational work for new FSS. A special cadre, multiplying its numbers out of its own operations, should take the responsibility of forming new FSSs and getting them ready for business. The cadre should be incorporated preferably into one or more existing organisations with extensive all India experience of agro-based development. These organisations would take the responsibility of managing such cadres, launching new societies and providing consultancy for overcoming initial difficulties.

12.1.22 There is need for caution and proper phasing in the establishment of FSS. The spearhead teams should exercise due care in the selection of areas. A beginning should be made with only one team of five persons in five States as the core. It would attempt to launch 20 societies and train an equal number of Managing Directors in the first year. They should plan their operations in such a manner that over a period of six years, the cadre would consist of about 250 persons in the spearhead teams and 68 resident trouble shooters looking after groups of 20 societies each. During this period 2,500 societies would have been launched and a capacity to form new societies at the rate of 1,000 per year created.

Mobilisation of Institutional Financial Resources

12.1.23 The credit requirements in respect of agricultural sector

have been assessed by the Commission in respect of development programmes both in irrigated and unirrigated areas, and include investments in land development and irrigation as also in allied programmes relating to livestock, fisheries and forestry development for all types of farmers. For estimating the magnitude of credit requirements for crop production in 1985, the net irrigated and unirrigated areas have been apportioned between the size of upto 2 ha and above 2 ha in the same proportion as were prevailing in 1970-71. Also, the detailed assumptions made are given in Appendix 12.1.

12.1.24 On these considerations, the full credit requirements for agricultural sector in 1985 are estimated at Rs 16,550 crores including Rs 400 crores for farm machinery and implements. The actual requirements may, however, be lower considering the amount of surpluses, which might become available from the larger land holdings, and also considering the limitations of financial, personnel and organisational resources. A more realistic estimate of the credit requirements has, therefore, been derived on the basis of graduation of full requirements in regard to coverage and also the scale of financing, particularly in the rainfed areas. The following table gives the full and the graduated requirements in 1985 :

TABLE 12.1
Credit Requirements for 1985
(Rs crores)

	Short-term		Medium Term		Total	
	Full	Graduated	Full	Graduated	Full	Graduated
marginal and small-farmers . . .	2,193	1,766	2,497	2,022	4,690	3,788
Medium and large farmers . . .	5,691	2,242	5,768	3,003	11,459	5,245
Total . . .	7,884	4,008	8,265	5,025	16,149 + 400	9,033 + 400

The requirements of institutional finance for forestry development, which may amount to about Rs 790 crores up to 1985, has not been included in the present estimates of credit requirements, since this has to be negotiated with the ARDC and not derived from the cooperative system and the commercial banks.

12.1.25 Forty-five per cent of the graduated requirements of short term loans and 40 per cent of medium and long term loans should be met by the end of the Fifth Five Year Plan itself. During the period 1975 to 1985, the cooperative societies should strive to almost double their short, medium and long term credit and the banking system

should work towards increasing their agricultural loans from Rs 1,450 crores in 1978-79 to Rs 4,050 crores in 1984-85. The Reserve Bank of India and the Government should immediately initiate planning for business and manpower development to equip them to achieve these targets.

Measures for Implementation of National Policy

12.1.26 The success of the new credit policy would depend, to a great extent, upon the creation of conditions in which the farmers can make productive use of credit. Keeping this objective in view storage and marketing system should be developed to keep pace with the expansion of output generated by credit service. Storage development, preferably by the FSS and the cooperative sector, should start right at the farm. The negotiability of warehouse receipts should be improved. Besides, in surplus districts, the FSS can operate as the agents of the Food Corporation of India for purchase operations at declared prices.

12.1.27 Location of new branches of commercial banks in rural areas should be related to concentration of small farmers to ensure reasonable proximity and mutual access. The bank and the cooperatives should give priority to the needs of the nonborrowing members, blending credit with services. The institutional financing agencies should not accept past debts of private moneylenders. These debts should be scaled down in the light of the prevailing regulations regarding debt redemption. Outstanding amounts should be taken care of by the period of repayment being extended and by making production programmes of the farmers so broadbased as to take care of the repayment of not only the instalments of old loans but also the due instalments of new loans. The FSS can help in observing a discipline so that the genuine cases are disposed of fairly by a convention.

12.1.28 It is also important that the major public sector banks should keep a horizon of the next 10 to 15 years in view and start remodelling their setup and composition of personnel for agricultural financing. The concept of linking specific investments for local agricultural development with locally mobilised savings should be adopted. It should be possible to have specific schemes of a local nature ready for implementation from these resources.

Other Incentives including Subsidies

12.1.29 Apart from credit, other incentives in the form of subsidies and rebates, infrastructure, services and institutional changes are also

necessary for increasing agricultural production. The use of subsidies as a tool for accelerating agricultural development has been in vogue in India for the last three decades. Under the Fourth Plan, subsidies were allowed only on a selective basis, and not for agricultural development programmes in general. Subsidies were also provided under certain special programmes like the SFDA, MFAL and Integrated Dry-land Agricultural Development Scheme. The basic principle of selective application of subsidies should continue. The subsidies should be given only to the small and marginal farmers and agricultural labourers, who have not benefited much from the massive investments made by the State in agricultural development so far. The policy for subsidies should also be based upon the principle of subvention for those classes, sectors and key programmes that need support in the interest of balanced and quick development and in keeping with the objective of growth with social justice. The attempt should be to use the intrinsic methods of motivation more and more and depend less upon the extrinsic ones.

12.1.30 Subsidies may be provided where the cost of inputs is unduly high and for introducing and popularising a new practice or programme. In the present scheme of subsidies, export oriented crops occupy a special position in view of their importance from the national angle. Subsidies on these crops should be reviewed periodically and should be discontinued as soon as the purpose has been served and are no longer justified.

12.1.31 There are also a number of other areas specially for the weaker sections of the society where grant of subsidies would be justified. Specific recommendations in regard to subsidies on such items have been made in the different chapters of the Commission's Final Report.

12.1.32 Tax rebates and tax concessions in respect of selected items have a role in promoting the growth of agriculture. The question of introducing crop insurance against droughts, floods, pests and diseases for providing a minimum security to the farmer at the production stage has engaged the attention of the Government for a long time. Schemes for crop insurance are currently in operation in ten projects, on a pilot basis, and mainly relate to cotton and groundnut. There is only a lone project in cereals in Maharashtra. Pilot schemes should be organised for more crops, particularly foodgrains, in the different regions of the country so that a complete picture of feasibility of the scheme could be available for different crops and regions and the scheme introduced soon thereafter, wherever possible. In areas with low productivity and high fluctuations in yield, the premium rates may be kept low considering the farmers' capacity to pay as a

social welfare measure. The demand for insurance of capital assets can be expected to be greater than the demand for crop insurance. This aspect may be examined in detail with a view to evolving a practical approach.

12.1.33 A substantial and sudden increase in production due to technological improvements and other favourable factors may pose yet another risk for the farmers in the form of a steep fall in prices and consequent reduction in their incomes. While in the case of foodgrains, arrangements for ensuring the minimum prices are fairly satisfactory over large areas, in the case of commercial crops like cotton, jute etc., these arrangements need to be improved adequately.

12.1.34 Tangible rewards and social recognition of outstanding farmers who obtain the highest yields act as social incentives for adoption of improved agricultural practices. A scheme of national crop competitions for foodgrains crops is already in operation since 1949-50. Under this scheme, crop competitions are held at the village, block, district and State levels by the State Governments and at all India level by the Central Government. The system of National Awards Competitions gets limited to a select few. It is necessary to institute a system of competitions with a wide appeal, under which all those who reach specified yield levels should be recognised. All India competitions for fruits, milk and eggs, etc. which are currently being organised should continue. There should be greater social and community recognition to innovating and enterprising farmers who have distinguished themselves by achieving greater productivity irrespective of their economic status.

2 MARKETING, TRANSPORT AND STORAGE

12.2.1 Agricultural marketing includes all aspects of market structure and systems, both functional and institutional, pre and post harvest operations, assembling, grading, storage, transport and distribution. Facilities and infrastructure for agricultural marketing in the country have to be considerably improved and strengthened in order to enable the agriculturists to dispose of their produce at incentive prices, reduce the price spread between the primary producer and the ultimate consumer and ensure the availability of consumer products and agricultural inputs to the farmers at reasonable prices.

Markets and Marketing Institutions

12.2.2 The present marketing structure for agricultural commodities in the country consists of about twenty-two thousand hats or

shandies, each serving, on an average, an area of 8 to 16 Km radius; 4,145 secondary markets, also called wholesale or assembling markets, each serving an area of 775 sq km and 1.32 lakh population; periodic markets, town based hawkers and representatives of big traders, who are available at the farmer's doorstep to buy his produce or sell consumer goods. The farmer, however, does not get a fair deal in the existing marketing structure because of his poor holding capacity and trading malpractices.

12.2.3 To get a fair deal, a market should be available at distance, say, within a radius of 5 km, which is negotiable by foot or by cart by the farmer. To achieve this, the existing *shandies* should be restructured either as assembly or submarkets, depending upon their location, volume of commodities traded, and number of buyers and sellers. At the submarkets, there should be adequate facilities for grading, weighing and storing of all commodities. Of the existing secondary or terminal markets about 70 per cent are regulated. Steps have to be taken to bring not only the remaining assembly and terminal markets but also the primary markets under regulation. Though the regulated markets have brought considerable benefits to the producer-seller by preventing trading malpractices such as unauthorised market charges, falsification of weights and measures etc., the functioning of these markets leaves much to be desired. To improve their functioning, each regulated market should have a duly constituted market committee to supervise the market in accordance with the rules and regulations as formulated by the Agricultural Produce Marketing (Regulation) Act. Growers should have major representation in the market committee and the Chairman and Vice-Chairman should be representatives of growers only. All commodities of crop and livestock origin and minor forest produce should be notified at every market to make the Act really meaningful. All the transactions of purchase and sale of notified agricultural commodities produced in the specified market area should be conducted within the regulated market only and not outside. The levy of market fee should on *ad valorem* basis. The market area should comprise of a revenue subdivision of a tehsil or taluk. Each such market should also have an adequate market yard and administrative block to accommodate officials of the market committees, market functionaries, post and telegraph office and bank. Further, each market should have an optimum number of warehouses for storing the produce. A regulated market should have a minimum number of qualified people to operate the market efficiently. The persons, who are vital to operate a market, are Secretary, Supervisor, Market Intelligence Inspector, Grader and Auctioneer. Sale of produce at these

markets should be by open auction and/or tender system as far as possible. The implementation of these measures will improve market income sufficiently to meet not only the operational expenditure but also the cost of development.

12.2.4 The primary markets, which are to be developed as assembly markets and sub markets, may not be able to devote necessary funds for providing physical facilities in the initial stages. It is, therefore, felt that all State Governments should create a Market Development Fund to which market committees should contribute a certain percentage of their revenue and the State Government the matching grants. This fund could be utilised for developing financially weak markets. Several State Governments have formulated projects for integrated development of markets and are seeking financial assistance from the World Bank. It is the view of these State Governments that the revenue of the market committees would substantially increase thereby enabling them to repay the loans received for development. Other States should also take up such integrated market development plans, in a phased manner, instead of attempting to improve a few markets in isolation.

12.2.5 The objective of reorienting the agricultural marketing system should be to give to the farmer the benefit of a good market facility without subjecting him to the intricacies of market transactions. The primary cooperative marketing societies can render this service. It would be necessary to expand their network so that ultimately these societies could open branches. The farmer's service societies proposed in the preceding section, should assist the cooperative marketing societies and perform marketing functions on their own where cooperative marketing societies do not exist. The Food Corporation of India and other commodity corporations should also strengthen their relationship with the primary societies and encourage them to undertake purchasing activity on their behalf.

12.2.6 Unnecessary intermediaries, like brokers, should be phased out from the market. Market functionaries, like commission agents and traders, should be licensed. The State marketing authority should issue licences to functionaries operating within a State and the Directorate of Marketing and Inspection (DMI), Government of India to those who operate in more than one State. The weighing of produce should be done by the market committees, and only duly weighed and graded produce should be handed over to the commission agents. The system of payments through banks located in all regulated markets needs to be popularised.

Input Marketing

12.2.7 It is important from the point of view of augmenting agricultural production that all inputs needed by the farmers for agricultural operations should be made available to them on time and at reasonable prices. Similar arrangements for supply and service of farm machinery and implements are also necessary. Suitable marketing facilities are to be built up on an adequate basis so that all the farmers could obtain the needed inputs from any of the three channels, namely, the primary cooperative marketing societies, agroindustries corporations and sale depots of the private traders. The farmers' service societies should also be entrusted with the running of input depots in respect of seed, fertilisers and insecticides or pesticides.

Output Marketing

12.2.8 In the case of crops, output marketing includes the stage of pre and post harvest techniques and transport and the disposal of the produce for further processing or consumption. Livestock and livestock products need special care before they are taken to the market for sale. Research should be done on improving pre-harvest treatment of crops, prevention of post-harvest losses and improving the quality of agricultural products intended for marketing. Some of the areas which require priority attention are :

- (i) use of mechanical driers for pepper berries;
- (ii) standardisation of drying and bleaching process for ginger;
- (iii) discouraging the use of cow dung cooking and lead salts to brighten the colour of turmeric;
- (iv) improving flue-curing barns for tobacco;
- (v) establishing ribboning and decorticating centres in jute growing areas to be operated through the village panchayats or FSS;
- (vi) modernising sheller mills for paddy;
- (vii) conducting detailed feasibility studies on the number and location of modern rice mills;
- (viii) phasing out traditional *dal* mills and establishing mills equipped with improved technology based on the research findings of CFTRI;
- (ix) evolving new types of gins and presses and encouraging their indigenous fabrication; and
- (x) designing and popularising low cost small capacity sugar-cane crushers.

12.2.9 In the field of processing of agricultural commodities, it is

necessary to break the monopoly of the private sector. A chain of efficiently operated processing units should be established in the co-operative sector, and to ensure regular supply of raw material, they should be linked with the primary cooperative marketing societies. Marketing orders and agreements between growers and processors should be encouraged. Feasibility studies should be conducted before establishing processing units so as to utilise the capacity to the maximum and economise on operational costs.

12.2.10 Facilities for grading agricultural produce have to be considerably strengthened. Grading of all agricultural commodities, raw, as well as processed, should be made compulsory and all products meant for inter-State trade should be graded, inspected and certified by the staff of the DMI. All markets brought under regulation should have facilities to grade all agricultural commodities. Grading supervisors and graders working at these markets, as also in warehouses of FCI, Central and State warehousing corporations and primary cooperative marketing societies, should be the employees of the Marketing Departments only.

12.2.11 There is need for evolving a simple procedure for grading at producer's level by laying down one or two recognized quality factors in the case of each kind of produce. The grading and inspection of export consignments before shipment need to be strictly enforced by the DMI acting as an export inspecting agency on behalf of the Export Inspection Council.

12.2.12 For financing orderly marketing of increasing levels of marketable surpluses in the coming years, commercial and cooperative banks would be required to play a vastly expanded role. A committee should be constituted by the Reserve Bank of India to examine the credit needs of all the agencies performing marketing functions with particular reference to (a) quantum of credit to be made available to private, cooperative and public sector agencies; (b) rate of interest to be charged to these agencies and (c) the number and order of priority of commodities for which credit is to be provided.

12.2.13 Special measures are necessary to facilitate the marketing of specific agricultural commodities. In the case of perishables, there should be a Central legislation to suppress unfair and fraudulent practices in inter-State trade. Packaging of these commodities requires urgent attention, particularly aspects like designing of suitable cardboard boxes scientific use of paper for wrapping, padding and lining.

12.2.14 For marketing of livestock produce, State Marketing Departments should provide temporary physical facilities for orderly transactions at cattle fairs and depute officials to supervise trading. Separate space has to be provided within the marketing yards of regu-

lated markets for trading in livestock, and where there are no regulated markets suitable arrangements for supervising trading in these products are needed. The primary cooperative marketing societies or wool boards should assist sheep breeders in assembling, grading, transporting and selling of wool. Curing centres have to be set up in rural areas and in the vicinity of slaughter houses. Poultry farmers' associations or cooperatives should organise the marketing of eggs from collection to sale in terminal markets on behalf of poultry breeders. They should also go in for processing of poultry products in urban areas.

Transport

12.2.15 Road transport plays an important role in agricultural marketing. Their weakest point is, however, below the town level i.e. rural roads. Village roads should, therefore, be improved by Zila Parishads and roads between primary market centres and towns by the Public Works Department (PWD). Market committees should contribute from their revenue towards development of these roads. The Central Road Research Institute should intensify research on construction of semipucca roads from locally available materials. Construction of all weather roads in hilly areas where fruits and vegetables are grown should be taken up on priority basis. Introduction of helicopter service in the inaccessible areas also needs consideration. To improve the modes of transport, the regional research-cum-testing centres should redesign the conventional bullock cart to improve its technical efficiency.

12.2.16 Efforts have to be made by the railways to increase the number of quick transport services, reduce detention time at transhipment points, and avoid procedural delays at the time of booking and unloading. Rationalisation of freight structure for fruits and vegetables and an increase in the number of refrigerated and insulated wagons to be attached to express or mail trains would go a long way in facilitating the marketing of these commodities. Detailed studies would have to be undertaken to assess the requirements of various types of rail vans needed at each production and marketing centre so as to make maximum use of scarce finances available. Sample traffic surveys should be conducted in selected areas to collect data on quantity and type of commodities moved to find out wasteful use of transport facilities and suggest better method of effecting transport. Special types of trucks have to be designed to transport by road perishable commodities and livestock. Covered sheds should be provided at checkposts on highways where the trucks are likely to be detained. In designing trucks for livestock, the objective would be to prevent bruises and shrinkage in transit.

Storage

12.2.17 Government should not depend on private agencies to store foodgrains needed for public distribution. The storage capacity of the FCI, Central Warehousing Corporation (CWC) and State Warehousing Corporations (SWC) should be increased to store foodgrains required in cities, industrial towns, drought prone and flood affected areas. The FCI should give priority attention to the construction and maintenance of silos and flat type warehouses to store foodgrains needed for public distribution and buffer stocks. Since many quasi-government agencies and cooperatives are likely to be engaged in the construction and operation of warehouses in each State, a committee consisting of representative of the FCI, CWC, SWC and cooperatives should be set up to coordinate their activities. The existing All India Coordinated Project on Grain Storage should be suitably modified and instead, an All India Coordinated Project on Post-harvest Technology should be instituted, with a coordinator at Hapur and research units at State agricultural universities.

12.2.18 Improvement of storage facilities for certain commodities needs special attention. The cooperative marketing societies and regulated markets located in cotton growing areas should plan an increase in the capacity of warehouses according to requirements in different areas. The Cotton Corporation of India (CCI) should advance money to producers on warehouse receipts issued by the CWC, SWC and the primary cooperative marketing societies. In jute growing areas, co-operative marketing societies have to be organised to provide the much needed storage and credit facilities at the assembly points and regulated market complexes. Adequate measures have to be taken by cooperative and public sector undertakings to provide cold storage facilities in production areas and terminal markets to facilitate the storage and transport of perishables like fruits and vegetables with a view to preventing the fall in their prices to uneconomic levels in the post-harvest period. It needs to be examined if steps could be taken under the Cold Storage Order, 1964 to fix maximum rental charges and earmark storage space for the commodities.

12.2.19 Improved storage structures needed by farmers should be manufactured by agroindustries corporations and other entrepreneurs as per ISI specifications. Research on designing improved storage structures, using locally available material, should be taken up by State agricultural universities. It would be necessary to train the existing staff at the block level to conduct demonstration and training of farmers in methods of scientific storage and pest control. The measures needed to prevent storage losses are : (a) popularising the use of che-

micals to control losses in storage due to insect pests and rodents; (b) storage of grains after proper drying; (c) fumigation of storage structures and dipping of bags in pesticide solutions; and (d) removal of grains stored in bulk to prevent further damage when there are signs of bad smell or discolouration.

Marketing Education, Research, Extension and Administration

12.2.20 Courses leading to a degree in agricultural marketing should be instituted at agricultural universities. Whereas one year diploma courses and courses for market secretaries and grading supervisors should continue to be organised by DMI, graders' courses in specific commodities should be conducted by the State Marketing Departments. Extension education in marketing also needs to be improved. Agmark exhibitions should be held in rural areas and steps taken to distribute extension literature in marketing to farmers through regulated markets, primary cooperative marketing societies and FSS.

12.2.21 Research in marketing needs the active cooperation of various agencies like the ICAR, Directorate of Economics and Statistics, DMI, Agricultural Prices Commission, commodity corporations, Railways and Transport Ministries at the Centre as also Departments of Agriculture, Animal Husbandry, Horticulture and Fisheries at the State level. There is, therefore, need for initiating an All India Co-ordinated Research Programme on Agricultural Marketing under the ICAR.

12.2.22 At the Centre, DMI should be suitably strengthened with the creation of four units each headed by an officer of the rank of Joint Agricultural Marketing Adviser viz : (a) grading, standardisation, inspection and certification; (b) marketing surveys, coordination and extension; (c) training, planning and development; and (d) supervision and regulation. A Central advisory committee on agricultural marketing should be established with the Principal Secretary in the Ministry of Agriculture and Irrigation as Chairman and consisting of representatives of departments concerned with different aspects of agricultural marketing and four State Governments by rotation. In each State, there should be a Directorate of Agricultural Marketing. State Agricultural Marketing Boards, with both advisory and policy functions, should be set up in those States where they are not already in existence

3 PROCESSING AND AGRO-INDUSTRIES

Processing

12.3.1 Preservation of fruits and vegetables on a commercial scale, using modern techniques, is of recent origin in India. The production of fruit and vegetable products in the country increased from 9,500 tonnes in 1952 to 49,100 tonnes in 1970. It is estimated that in 1970 nearly 21 per cent of the products were exported and the balance used for defence forces and civil consumption. There is considerable scope for expanding exports further if tastes and preferences in importing countries are given due consideration in the production programmes. A constant watch needs to be kept over the kinds of commodities in demand in export markets and the forms of preservation and packing etc. preferred.

12.3.2 Imports of tin plate have to be effected to meet its demand for the manufacture of containers. Due to nonuniformity in quality and the higher cost of imported material, the manufacturers have often to suffer heavy losses. Tin plate with low phosphorus content suitable for canning purposes should be manufactured in the country and made available to the confabricators at reasonable cost. Import of adequate quantities of tin plate should, however, be continued till the local production is sufficient to meet the demand of the industry, both for export and for internal consumption. The cost of tin cans should be kept within reasonable limits by reducing the charges levied on imported tin plates. There is also a case for relieving the burden of taxes on canned and bottled products.

12.3.3 In the case of products like jams and jellies, where sterilisation of the products is not necessary, glass containers are generally used for packing. Imports of canning jars are now negligible. The domestic glass industry should be encouraged to produce canning jars of required quality. Research effort for producing plastic containers suitable for use in the preservation industry needs to be stepped up. Research is also needed to determine whether processed food articles, which are in contact with preservatives and tin or plastic containers, are safe for habitual users, and, if not, what type of containers have to be developed. It is desirable to lay down and enforce the microbial and hygienic standards which should apply to fruit and vegetable preservation industry in the country. The levels at which sulphur is injurious in jams needs to be determined and specifications should lay down these levels instead of insisting upon the products to be completely free of this element.

12.3.4 Sugar and raw fruits are the major items in the cost structure of the industry. Sugar should be made available to the industry

at controlled rates uniformly irrespective of whether the product is meant for export or home consumption. Compulsory grading of fruits and vegetables should be enforced in the markets according to ISI specifications and the fruits discarded for edible purposes should be made available to the processing industry at cheaper rates. The processing units should be established near the market sites preferably in the small and medium sectors.

12.3.5 Dehyderation on commercial scale has so far been tried in the case of peas and onions only. Special attention should now be given to tuber crops, particularly potato, whose production is likely to increase substantially in the future. Big dehydration plants should be installed for potatoes in the immediate vicinity of wholesale markets so as to save time and money in transport.

12.3.6 The production of meat products like pork, ham, bacon, and sausages is increasing in the country. The feasibility of utilising broilers and culled birds for the canning industry should be explored.

Expanding Uses of Agricultural Commodities

12.3.7 Foodgrains and other agricultural raw materials are being increasingly used in a number of industries. Breads, *nans* and biscuits are some items of daily use which have gained popularity even in the rural areas. There is need to establish manufacturing units in towns and rural areas to produce nutritious bakery and confectionery items under hygienic conditions. The equipment used in the preparation of parched products from cereals and millets should be modernised. More manufacturing units should also be set up for the preparation of malt syrup and other malted products and beer and for this purpose, the indigenous cultivation of hops should be encouraged for use in the production of beer.

12.3.8 Some the new uses, which could be tried for further development are :

- (i) use of millets in manufacturing starch, glucose syrup and bakery and confectionery products;
- (ii) use of steep water from wet milling of maize and jowar as a nutrient medium for the culture of micro-organisms in antibiotics industry;
- (iii) identification and separation of chemical ingredients of foodgrains which have potentialities in industry;
- (iv) use of carbondioxide, which is obtained as a byproduct of the fermentation industry, for preservation purposes either in gaseous form by providing an inert atmosphere or in the form of dry ice which lowers the storage temperature;

- (v) preparation of protein-concentrates and isolates from pulses;
- (vi) preparation of gum from guarseed and other gum yielding plants for export purposes;
- (vii) manufacture of golden syrup, rich in glucose from sugar-cane crop of tender age;
- (viii) exploitation of soyabean proteins and oils for industrial purposes;
- (ix) preparation of vegetable milk from soyabean and ground-nut;
- (x) preparation of industrial starch and sago from tuber crops particularly tapioca, both for domestic consumption and exports;
- (xi) manufacture of products like garlic powder, alcoholic and nonalcoholic beverages and oil and oleoresins from ginger and flavouring constituents from turmeric rhizomes etc.;
- (xii) preparation of fibre from banana stem and pineapple leaves and oxalic acid and manital from pineapple;
- (xiii) extraction of essential oils from the peels of oranges and lemons;
- (xiv) preparation of pectin from citrus fruits, apple, guava and papaya and papin from mature raw papaya fruits;
- (xv) manufacture of finished products from medicinal and aromatic plants grown in the forest for domestic use and exports if necessary, suitable restrictions may be imposed on the export of raw materials from the country;
- (xvi) finding alternative uses for (a) coconut kernel, husks and leaves; (b) coir and (c) forest products and stepping up their production; and
- (xvii) utilisation of byproducts and waste products of animal origin for industrial uses.

Utilisation of Byproducts and Wastes

12.3.9 The exploitation of byproducts and waste products has not crossed the experimental stage because of the involvement of a large number of laboratories and institutes. There is a need to set up a separate organisation to explore and develop new uses of all agricultural commodities as well as commercial utilisation of byproducts and wastes. A Central laboratory for industrial utilisation of agricultural products under the aegis of the ICAR with the status of a National Laboratory might be established. The main objectives of the laboratory would be to keep a constant watch on the new uses of agricultural

commodities, byproducts and wastes, select and carry out feasibility trials on the most promising ones for commercial utilisation before passing them on to the industry. The laboratory should maintain proper coordination with other institutes to avoid duplication in research. Considering the enormity of the work, small technological units should also be set up in the agricultural universities and Central institutes of the ICAR for preliminary work which would thereafter be passed on to the Central laboratory for specialised attention.

Commercial Exploitation of Agricultural Products

12.3.10 The All India Khadi and Village Industries Commission, All India Handloom Board, Handicrafts Board, Central Silk Board, and Coid Board are some of the important organisations which have been making appreciable endeavours in the commercial utilisation of various agricultural produce. The Small Scale Industrial Development Organisation (SIDO) deals with the activities of agrobased industries and coordinates the same at the Centre. A number of governmental and quasi-governmental agencies are assisting the development of agrobased industries like the Directorate General of Technical Development (DGTD), the Department of Cooperation through the National Cooperative Development Corporation (NCDC) and the agroindustries corporations of different States. There is also a Central committee which coordinates and promotes the developmental programmes of various agroindustries. Thus, while the requisite organisational setup exists, the need is for a more invigorating drive and a far greater coverage than the past efforts. The industries which are not covered by the various governmental and quasi-governmental agencies, should be encouraged or taken over by the State agroindustries corporations. For the expansion of small and medium industries on these lines and for the participation of the rural population in these ventures, the required backing in the form of finance, material and marketing would be necessary. The proposed Central laboratory should be able to devote attention to the development of appropriate intermediate level technology suitable for adoption in the rural areas.

Role of Agroindustries Corporations

12.3.11 The agroindustries corporations should participate in processing and manufacturing activities on the basis of a common pattern applicable throughout the country. The spheres of activities could be : (a) agricultural processing industry; (b) preservation industry relating to perishable commodities; and (c) selected agrobased industries. The

corporations should render all possible help to private entrepreneurs or cooperative enterprises, particularly those functioning on a small or medium scale. They should shoulder the responsibility for purchase and sale of the products manufactured by units in small and medium sectors operating under their patronage. The corporation should be directly responsible for establishing agroprocessing industries in inaccessible areas.

12.3.12 A coordinating body should be set up under the aegis of the Ministry of Agriculture and Irrigation at the Centre to develop and coordinate agroprocessing activities and avoid duplication of effort among organisations.

APPENDIX 12·1

(Paragraph
12.1.23)

Rs.

Assumed Credit Requirements for Agricultural Programmes**Crop production****short term loan:**

presently irrigated or newly irrigated areas	per ha	600
unirrigated areas	per ha	450
medium and long term loan:		
for preparation of land covered under major and medium irrigation (8 Mha)	per ha	1,350
for improvement in 5 Mha already developed under major and medium irrigation	per ha	200
for improvement in areas covered by minor irrigation (1 Mha)	per ha	200
groundwater development 9 (Mha)	per ha	1,000
land development in unirrigated areas—levelling soil conservation water harvesting, ponds etc. (98 Mha)	per ha	500

Milk Production**medium term loan :**

for 5·7 million small and marginal farmers	per farmer	500
for 0·3 million other farmers	per farmer	2,000

Piggery :

for small and marginal farmers and agricultural labourers for 2 lakhs units :

short term loan	per unit	5,900
medium and long term loan	per unit	1,530
for other farmers for 1 lakh units :		
short term loan	per unit	1,560
medium and long term loan	per unit	3,060

Poultry :

for small and marginal farmers and agricultural labourers for 5 lakh units :

short term loan	per unit	1,560
medium and long term loan	per unit	1,800
for other farmers for 2·5 lakh units :		
short term loan	per unit	3,120
medium and long term loan	per unit	3,600

APPENDIX 12·1 (Contd.)

Sheep

for small and marginal farmers and agricultural labourers for 4·2 lakh units :

short term loan	per unit	480
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medium and long term loan	per unit	2,160
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for other farmers for 2·1 lakh units :

short term loan	per unit	960
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medium and long term loans	per unit	4,320
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Fisheries:

short term loan for small fishermen for 1 Mha	per ha	2,220
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medium and long term loan for small fishermen	per ha	75,00
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for repair of existing ponds 0·54 Mha	per ha	75,00
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reclamation of fresh and brackish water swamps	per ha	12,500
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36,000 ha each	per ha	12,500
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13

RURAL EMPLOYMENT AND SPECIAL AREA PROGRAMMES

1. RURAL EMPLOYMENT

13.1.1 Rural employment in this country is more in the nature of underemployment of varying degrees than of long spells of complete unemployment. The remuneration for some amount of employment, which may be forthcoming, is also low, the labour market being the least paid among the employment markets. Labour in family agricultural operations is also highly unremunerative. Agricultural labour market is also one of the least paid of the employment markets; wages are generally low. A substantial section of the rural labour force, therefore, lives in a state of utter poverty. An effective employment policy is the most appropriate instrument for achieving growth with social justice and removal of poverty within the frame work of the existing economic and political system.

13.1.2 Because of its magnitude and nature, it is necessary to take an integrated view of the problem of rural employment, as the problems of agricultural employment cannot be considered in isolation from the problems and possibilities of nonagricultural occupations in the rural areas. Bulk of the rural labour force even in 2000 AD will continue to depend on agriculture and allied nonagricultural rural occupations, as the transfer of the labour force from agricultural to urban nonagricultural occupations will be rather slow even after an optimistic view is taken of the creation of urban employment opportunities. Agricultural development alone cannot solve the problem. There will have to be a two pronged employment strategy in the future, firstly, all efforts will have to be made to generate additional employment in the various agricultural activities and secondly, the potentialities of employment in the nonagricultural rural activities will have to be fully exploited in order to accommodate those who cannot find work in landbased occupations. In planning individual projects and programmes for growth and employment creation, the needs of the weaker sections of the rural community should receive the first priority.

Growth of Rural Labour Force

13.1.3 The projections of the rural labour force given in Table 13.1 show that though there may be some decline in the share of the rural labour in the total labour force, the increase in absolute number of rural labour will be considerably large, i.e. between 105 and 111 million. Indications are that the participation rates by sex and age will increase though at a declining rate. But whatever assumptions are made with regard to the participation rates, the total increase in the rural labour force will not be less than 100 million persons by the end of the century.

TABLE 13·1
Rural Labour Force Actuals for 1971 and Projections for
1986 and 2001 AD

(million)

Year	Labour Force		(excluding child labour)			
	Projection 1		Projection 2		Projection 3	
	total	rural	total	rural	total	rural
1971 . .	170·0 (31·1)	138·6 (31·6)	170·0 (31·1)	138·6 (31·6)	170·0 (31·1)	138·6 (31·6)
1986 . .	248·0 (33·8)	194·0 (34·7)	257·7 (35·2)	203·7 (36·5)	245·8 (33·5)	191·8 (34·4)
2001 . .	339·9 (35·9)	249·9 (37·4)	328·9 (34·8)	243·5 (36·5)	334·0 (35·3)	244·0 (36·6)

Figures in parentheses are participation rates.

13.1.4 Keeping in view the behavioural patterns of rural labour, there may not be any significant drop in the percentage of rural labour force dependent on agriculture unless alternative occupations in the nonagricultural rural sector are found. In planning employment, however, a detailed study of the characteristics of the rural labour force would be needed at the regional level taking into account various socio-economic and climatological factors. The trend is towards increase in the number of persons working on their own account and decline in unpaid family workers. Also, the participation rate among female workers is increasing. In formulating employment programmes the problem of unemployment and underemployment of female workers has to be reckoned, as it could become more acute in future with the increased participation of the female workers.

The Unemployment Situation

13.1.5 Several estimates have been made to quantify the magni-

tude of unemployment. The Committee on Unemployment (Bhagwati Committee) worked out estimates for rural unemployment for 1969 as 9.12 million manyears including 7.82 manyears as totally unemployed. The needed employment opportunities for that year were estimated by the Committee as 22.52 million manyears on the assumption that fulltime work would have to be provided to all the available labour force. Raj Krishna's estimates of rural unemployment were 26.2 million persons comprising 8.3 million unemployed and 17.9 million underemployed, as in 1971. These estimates of the requirements of additional employment appear to be inflated because of the implicit assumption that all the unemployed and underemployed are available for fulltime employment which, in practice, may not be the case. While opinions may vary regarding the precision and usefulness of the estimates, they clearly indicate the aggravating seriousness of the problem.

13.1.6 For a proper appreciation of the unemployment problem and the trends in the growth of the rural labour force, a disaggregated view is necessary considering the heterogenous character of the labour force. Aggregates as well as disaggregated estimates of unemployment and the additional employment to be created by the plan programmes would be useful and should continue to be attempted.

13.1.7 Underemployment or disguised unemployment and seasonality of work are important features of the unemployment situation. Underemployment is most acute among selfemployed workers engaged in small farms or traditional household occupations, and agricultural labourers. The incidence of seasonal unemployment may vary from region to region, and even within the same region over different seasons depending on climate, the cropping pattern and the socioeconomic factors, and affect different sections of the rural population differently due to the periodic entry into and withdrawal from the labour force.

13.1.8 Various socio-economic constraints and attitudinal factors restrict mobility of labour. A sizable proportion of the rural labour force is provided by members of the households, who are unaffected by the forces of demand and supply in a free labour market. While mobility of labour is an important factor to be taken into account for planning employment programmes, it may not be possible or desirable to develop these programmes to cater for lack of mobility on the part of the labour force in certain localities. In such cases deliberate efforts are required to develop greater mobility. Though the incidence of unemployment and underemployment is higher among women, their ability to avail of employment opportunities elsewhere is limited due to lack of mobility.

Programmes and Planning

13.1.9 Employment planning should attempt to match the employment potential of various programmes and the needs of the unemployed and underemployed placed in varying socioeconomic situations. In the absence of detailed information on the norms of employment generation, the emphasis in this section is on bringing out the main features of employment potential likely to be generated in different sectors by 2000 AD, except where quantitative estimates have been possible.

13.1.10 Additional employment opportunities will have to be created in the rural sector through modernisation and diversification. The application of improved technology in crop production in irrigated and rainfed areas, animal husbandry, forestry and fisheries hold out the possibility of considerably increased employment and income. There is sufficient potential for increasing the labour input and the per hectare productivity of labour in small farms through technological improvements. In assessing the potential, cognizance has been taken of the impact of mechanisation and land reforms.

13.1.11 Increased intensity of activities accompany and follow the new technology. The coverage of the entire cultivated area under improved varieties by 2000 AD and the introduction of multiple cropping will not only increase employment opportunities but also ensure a more even spread of the labour input. Mechanisation, if selectively introduced, can result in increasing cropping intensity and higher yield. Substantial increase in labour requirement is expected as a result of enlarging the irrigation coverage. The cropping intensity in irrigated areas would increase from 1.23 in 1970-71 to 1.38 in 2000 AD, as the net and gross area under irrigation go up from 31 Mha and 39 Mha to 61 Mha and 84 Mha respectively during this period. In rainfed areas also, the cropping intensity will increase from 1.16 to 1.30 as improved dryland farming technology is spread and increases labour requirement from 64 mandays to 80 mandays per hectare by 2000 AD. This will create additional employment of 11.0 million manyears by 2000 AD.

13.1.12 The development of surface and ground water resources for irrigation will generate increased employment on account of construction activities, land formation and lining of water courses and operation and maintenance of irrigation works. These would in all increase the employment potentialities from 2.1 million manyears in 1970-71 to about 4.5 million manyears by 2000 AD. Similarly, there is considerable scope for additional employment in soil conservation and land development work.

13.1.13 Next to crops, animal husbandry programmes have the largest employment potential. They provide gainful employment through subsidiary occupations at the location itself and make better utilisation of the family labour. They are labour intensive, have favourable cost-benefit ratio and in some cases, a short gestation period, and are particularly suitable for the weaker sections. Rearing of livestock, apart from offering substantial direct employment, has also a large inbuilt potential for generating indirect employment in several ancillary activities like manufacture of livestock feed, fabrication of dairy and poultry equipment and a large number of animal based industries concerning hides, skins, bones, wool, bristles, etc.

13.1.14 As a result of developmental activities envisaged, the productivity of animals will increase. This will lead to greater work opportunities connected with their maintenance, processing and distribution of a considerably larger availability of animal products and supply of inputs. The total livestock population including poultry is likely to go up from 492 million in 1972 to 708 million in 2000 AD. As a matter of policy, the number of unproductive animals is to be decreased and that of productive ones increased by 2000 AD. The total number of cattle may increase up to 1980 and thereafter, start showing a downward trend. On the other hand, the sheep population will increase both in number as well as in quality. A substantial rise in the poultry population, from 137 million in 1972 to 372 million in 2000 AD, is envisaged. Improvement of the quality of pig stock and an increase in their number are also expected.

13.1.15 The fisheries employ comparatively a very small percentage of the rural labour force, part-time employment being characteristic of inland capture fisheries, where the magnitude of work varies with the seasonal flow of water, and sea fisheries based on migratory species. The employment potential of distant water fishing operations, which are capital intensive, is small.

13.1.16 Aquaculture, based on the exploitation of reservoirs, village ponds and reclamation of swamps, accounts for the largest part of employment potential in the fishing industry. In addition, the possibilities of expanding the tertiary sector activities like preservation, processing and marketing of fish and fish products indicate considerable additional employment potential. The scope for such employment will substantially improve with higher productivity in the fishing industry as envisaged in the developmental measures in the future. The production of inland fisheries is expected to go up by 3.7 million tonnes from only 0.7 million tonnes in 1971 and that of marine fisheries to 3.5 million tonnes from a level of 1.0 million tonnes.

13.1.17 Employment in forestry is available in the offseason for

crop production and is complementary to the employment in farm production. As forests are located in backward areas, direct employment in forestry activities can benefit the backward communities, such as tribals. Since these activities require a high proportion of unskilled labour, the unemployed and underemployed agricultural labourers will largely benefit from them.

13.1.18 Forest development activities envisaged for production forestry, social forestry and minor forest produce are likely to generate substantial employment opportunities. In production forestry, the related activities are logging, regeneration and road construction. An additional production of about 35 million cubic metres of industrial wood and 50 million cubic metres of fuel/wood is expected by 2000 AD, which will substantially increase felling and logging operations. The concentrated regeneration, involving clear felling of forests, collection of seeds, raising nurseries, etc. would be of about 0.8 Mha in 2000 AD as against 300 thousand hectares in 1973-74. For adequate exploitation of forest resources, about 15,000 km of road construction, including main, branch and feeder roads, may have to be undertaken annually, thereby offering a substantial scope for employment.

13.1.19 Similarly, the extension of social forestry programmes, raising of shelter belts, roadside and canalside plantations and reforestation in degraded forests, are expected to considerably expand employment opportunities. The production of fuelwood and grazing operations will also provide more employment, particularly for the family labour. The collection and processing of minor forest produce, the development of which is envisaged, are done entirely as a subsidiary occupation and have a large employment potential. In addition, there is big scope for employment in the rural areas connected with the transport of forest produce and the forest based industries.

13.1.20 The various agricultural programmes are likely to generate, by 2000 AD, additional employment opportunities for about 52 million persons, as indicated in Table 13.2. These broad estimates do not take into account any additional impact of the special rural works and employment programmes, discussed hereafter, for which no quantitative estimates are available.

TABLE 13·2

Estimated Employment Potentials under different Agricultural Programmes
in Rural Areas by 2000 AD

(Million man-years)

Heads of development	Employment		
	Total 1970	Total 2000 AD	Additional 2000AD
(1)	(2)	(3)	(4)
crop husbandry			
(i) irrigated areas	15·0	35·0	20·0
(ii) rainfed areas	27·0	38·0	11·0
sub-total (1)	42·0	73·0	31·0
soil conservation and land development in rainfed areas :			
(i) construction and development of water resources*	0·5	1·0	0·5
(ii) land formation and lining of water courses	neg.	1·0	1·0
(iii) operation and maintenance of irrigation works *	0·4	0·8	0·4
sub-total (3)	2·1	4·5	2·4
animal husbandry			
.	32·8	42·5	9·7
fisheries			
(i) inland fisheries and aquaculture including mariculture	0·8	2·4	1·6
(ii) marine fisheries	1·0	2·0	1·0
sub-total (5)	1·8	4·4	2·6
forestry			
(i) production forestry	0·7	2·2	1·5
(ii) regeneration operations	0·1	0·4	0·3
(iii) road construction	0·1	0·2	0·1
(iv) social forestry	0·6	1·7	1·1

TABLE 13.2 (contd.)

(1)	(2)	(3)	(4)
(v) minor forest produce and ancillary activities	0·8	3·3	·2 5
sub-total (6)	2·3	7·8	5·5
total	81·5	133·2	51·7

* These programmes are essentially in the nature of infrastructure development and cannot strictly be categorised as agricultural production programmes.

OE—1972.

Note :—The quantitative estimates of employment indicated here represent 'whole-time employment in man-years of 300 days' each as distinct "from main activity status" employment recorded in the census operations in 1971.

13.1.21 Among the various employment programmes, the rural programmes have got a unique place, the object of which is to provide employment to cultivators with small holdings and agricultural labourers, particularly those in the poorest strata or hard core of the rural community. The limited experience of the operation of the Crash Scheme for Rural Employment (CSRE), sanctioned in almost all the districts, shows that the benefits were too thinly spread out and that there was no effort to relate these special programmes with the nature and magnitude of the problem of unemployment at specific locations and times of the year.

13.1.22 The Pilot Intensive Rural Employment Project (PIREP), sanctioned in 1972-73, was intended to provide employment for the residual number of unutilised mandays after the employment potential of all the existing and planned projects had been considered and throw up information on the methodological issues involved in generating employment in the rural areas. It was also required to make an assessment of the requirement of proper types of skills and make arrangements for the training of workers in them. The PIREP would, therefore provide the basis for integration of rural works programmes with other development programmes and help in removing gaps, in the form of skills, in the execution of schemes. Suitable steps may, therefore, be taken to evaluate its results with the minimum time lag and the scope of the scheme enlarged to cover a large number of districts.

13.1.23 The Drought Prone Areas Programme (DPAP) formerly known as Rural Works Programme, seeks to strengthen the agricultural infrastructure through drought mitigating productive works which will also generate employment for the rural labour. The projects of Small Farmers Development Agency (SFDA) and Marginal

Farmers and Agricultural Labourers (MFAL) also have* employment potential, particularly the latter in which the emphasis is on supplementary employment centred around areas of consumer demand. Since the programmes recommended in the case of marginal farmers are similar to those under the rural works programmes, the coverage of the composite SFDA/MFAL programmes could be extended adequately to bring within their purview similar employment generating programmes and the planning for small and marginal farmers and agricultural labourers done in an integrated manner through these agencies.

13.1.24 The experience of the working of the Employment Guarantee Scheme of Maharashtra is of particular significance in assessing the feasibility and the advantage of the rural works programme. The objective of the scheme are to guarantee and provided gainful and productive employment to all able bodied persons in the rural areas, who demand and register themselves for the purpose, in manual and unskilled jobs through durable and productive labour intensive works involving large expenditure on wages. Certain significant features revealed by the working of the scheme are : (a) people registering are far in excess of those who turn out at the work site; (b) the number turning out at the site or even of those registering has no relation to the agricultural labour population enumerated in the district (registration is related to the lack of steady work in agriculture, the nature of land holdings and the types of crops grown; and (c) more women turn out at the work site than men, implying thereby that the men usurp better labour opportunities in the village areas. In Maharashtra in a normal year in certain districts with poor agriculture, labour is forthcoming when employment is offered.

13.1.25 There is need for provision of regular dependable employment throughout the year through works programmes, which could draw away landless labourers prepared to be mobile and accept wage employment outside their villages. In order to ensure that the programmes may not lead to nonproductive work, there should be a proper preplanning and a shelf of projects to be drawn upon as the demand arises. The Maharashtra experience shows that whereas a large number of labourers registering for work were willing to go out for permanent employment, they were employed on small works nearer the village; but large scale canal works, which would absorb them easily were going without labour. It has been decided that labour, opting for more or less permanent employment, should first be directed to the various large scale plan works, and only after these

*The two programmes have since been merged into one following the recommendation of the Commission in its Interim Report on Reorientation of Programmes of Small and Marginal Farmers Development Agencies.

are saturated, smaller projects should be attempted. Such projects should, however, be kept ready for implementation when the labour demand rises due to a bad agricultural year and more work has to be provided near the village.

13.1.26 The development of infrastructure and services covering rural institutions and organisations, such as cooperatives, rural banks, agroservice centres and farmers' organisations, and constructions, like rural electrification, rural roads and communications and housing, is essential to make rural life more attractive and curb the unhealthy migration to towns arising out of inadequate amenities and services in the rural areas. Although direct employment in the development of infrastructure is limited, it would result in the growth of activities in the tertiary sector as well as the development of agrobased and other village and small scale industries. The tertiary sector represents, by far, the most dynamic sector in the creation of new employment in the developed countries.

13.1.27 Deliberate efforts will have to be made to decentralise, and shift to rural areas, the production of sophisticated goods and services at present concentrated in the urban sector. These cover items such as dairy projects, processed foods, primary processing like milling, tanning, oil extraction, processing, canning and preservation of fruits, packaging, storage, etc. The wide margin between the price received by the farmer and that paid by the consumer in the urban sector is accounted for by processing, marketing, transportation and advertising charges. These activities have large employment content. In order that the benefit of employment goes to the rural or semiurban areas, there is need for bringing activities such as wholesale and retail trade, distribution, packaging, processing and marketing within the fold of the rural sector in organised forms.

13.1.28 Despite best efforts to create additional employment in the tertiary sector, a large backlog of unemployment would still remain in the rural areas. The development of rural industries and decentralisation of the appropriate manufacturing units are necessary to remove this backlog. Broadly, industrial employment in the rural areas can be provided, firstly, through the expansion of the handicrafts and small scale industries, which have been traditionally in existence, as well as agrobased industries, and, secondly, by promoting the decentralisation of industry from urban to rural areas. The effort should be to strengthen the traditional village industries including *khadi* as also to identify new modern small scale industries with a strong economic base. The expansion of the various agricultural programmes and the resultant increase in rural incomes would provide the basis for the growth of agrobased industries as also the industries

catering to the consumption needs of the economically better off rural population.

13.1.29 Several steps are necessary to make the handicrafts and small scale industries viable. These include modernisation of production techniques to improve the quality of products and the productivity of labour, technical and financial assistance and assistance by way of supply of raw materials and implements and training facilities to improve skills and integration of very small units within the framework of a viable organisation like a cooperative. The linking of the decentralised sector of rural industries with agriculture by developing agrobased and input supplying industries, on the one hand, and with the large scale industries through the development of ancillary industries, on the other, will facilitate a balanced and interconnected development of these industries and ensure proper development of employment opportunities. It is necessary to continue the existing principle of reservation for the protection of small scale and traditional industries from undue competition to ensure their proper development. A review of the list of industries reserved for the exclusive development in the small scale sector may be made periodically in the context of the increasing relevance of agrobased and rural industries. To facilitate the development of secondary and tertiary activities, certain growth points or centres may be developed. These growth points will become centres for the organisation of extension, credit, marketing and other services to the farmers.

The Strategy and Policies

13.1.30 Of the total rural workers of 148.4 million in 1971, 9.8 million were child workers. The objective should be to remove children from the employment market and prepare them sociologically through education and training for more remunerative and skilled employment in the rural sector. This transformation, it is hoped, will take place much before 2000 AD. Among the workers other than child workers, 117.0 million (84.4 per cent) were employed directly in agriculture and 21.6 million (15.6 per cent) in non-agricultural occupations. According to projection 1 in Table 13.1, additional employment opportunities have to be found for 111.3 million persons in the labour force excluding children by 2000 AD. On the basis of the various programmes postulated, it should be possible to find full time employment of 300 days a year directly in agriculture for an additional 52 million persons.

13.1.31 Quantitative estimates of employment in respect of non-agricultural rural programmes are not available, except for a few items.

Emphasis has, however, already been laid on the need for diversifying employment opportunities and providing greater scope in the secondary and tertiary sectors for both increasing employment and remunerative employment in more skilled jobs. There has to be a national will to reserve the opportunities arising from the growth of the secondary and tertiary sectors for the rural sector, as the expansion of these two sectors is stimulated by rising demand for sophisticated processed food and processed agricultural raw materials with rising incomes in the urban areas. If such increased labour opportunities are substantially diverted to the rural areas and the growing opportunities in village industries are taken into account, the nonagricultural employment in the rural sector may absorb about 30 per cent of the rural labour force by 2000 AD. Every attempt should be made to ensure that measures required for this change in the occupational structure are adopted as a nationed policy. In absolute terms it will mean the employment of 75 million persons including an additional employment of 53.5 million. Together with the additional employment of 52 million in agriculture, an additional labour force of 105.5 million will, thereby, be provided full employment of 300 days a year.

13.1.32 It would, however, be reasonable to assume an optimum of 265 days as the measure of full employment for 2000 AD, which the various development and employment programmes are expected to lead to. This is in between the estimate of the Bhagwati Committee (273 days of 8 hours a day) and the conclusion derived from the Rural Labour Enquiry, 1964-65 (254 days). Based on this norm, the full employment opportunities estimated earlier would be equivalent to 119.6 million. However, since the generation of full time employment opportunities may not always fit in with the location of the wage earner and his predelictions towards mobility, the rural wage earner may not, on the average, work for the full 265 days being postulated. Therefore, the total work stock that will be created, will be shared by a greater number of people than what is estimated for full time occupation. This will have, in turn, a redistributive effect on income in favour of the weaker sections, as most of the additional employment will be unskilled jobs and will suit them including female workers. The additional labour force can, therefore, be found employment in the rural sector itself.

13.1.33 The effect of additional employment opportunities on rural poverty will depend, to a great extent, on the level of wages. A reasonable level of minimum wage must, therefore, be ensured along with guaranteed employment. With the expected increase in productivity and expansion of subsidiary occupations, it should be possible to pay wages at a reasonable rate. A minimum wage rate of Rs 6 per

day at 1974-75 prices should put an agricultural labour family of five persons above the poverty line, assuming two workers per family. The minimum wage for agricultural labour should be fixed periodically in line with the productivity levels in the agricultural sector.

13.1.34 The creation of whole time jobs should be restricted to those who are in a position to withdraw completely from land based occupations, particularly, the hard core of the rural poor. Due to a greater mobility of this class of workers, it should be possible to concentrate rural works programmes at selected centres and attract the workers by providing suitable wages.

13.1.35 The generation of employment should not be left to a few *ad hoc* employment programmes. The entire rural development plan should be reoriented towards larger employment within an integrated framework of policy and action and through proper coordination in the creation as well as utilisation of employment opportunities in the various agricultural and nonagricultural programmes. Detailed employment planning should be done at the micro level taking into account regional characteristics. Areas with higher incidence of unemployment should receive priority in the allocation of resources. There should be proper phasing of the employment programmes over time so that the labour rendered surplus under one programme could be utilised under other programmes.

13.1.36 The programmes for creating employment opportunities should have a sound economic basis and should not be in the nature of relief works or remedial measures. The object should be to raise the productive capability of the agrobased sector on a permanent basis. In order to utilise those factors of production which are plentiful in rural areas but are underutilised, effort should be to concentrate on such sectors and programmes where the labour requirement can be clearly identified. The district planning organisation, suggested in chapter 14, should collect information on the nature and incidence of unemployment and assess the working of the various employment generating programmes.

13.1.37 One of the aim of the strategy will be to reduce the unhealthy migration from rural to urban areas by providing varied and better employment and better amenities and services in the rural areas. In order to utilise the larger employment potential to be created, institutional facilities for training and research for the improvement of skills will require strengthening. The availability of educated manpower for various sectors of agriculture also needs to be ensured. The object should be to avoid shortages in respect of trained manpower even if this results in unemployed manpower on land in some cases. It is preferable to have a surplus situation, than one of shortage, if the nation is to go forward quickly.

2. SPECIAL AREA DEVELOPMENT PROGRAMMES

13.2.1 The hill, tribal, arid (both hot and cold deserts) and semi-arid drought prone areas in the country lag in development. The Kutch area in Gujarat and the Sundarban in West Bengal, which have salinity problems also need special programmes of development. In these areas the basic approach should be an integrated area development, considering the lack of development not only in agriculture but in every sphere including irrigation and other infrastructure, institutions, research education and attitude. Given the physicogeographical and cultural diversities among different areas and the people, it would be necessary to adopt different modes of development for different areas depending on the resources situation and the social and cultural conditions.

Hill Areas

13.2.2 The hill areas of the country comprise the Himalayan ranges including the western Himalayas, central Himalayas and eastern Himalayas and the north-eastern ranges and the hills of the Deccan Plateau. During the first three plan periods, development of hill areas did not receive adequate attention. But special area development schemes were taken up in backward areas during the Fourth Plan and experimental projects started in the hill areas. Greater attention to integrate development of the hill areas has been given in the Fifth Five Year Plan and efforts are being made by the States to prepare, in consultation with the Planning Commission, comprehensive and integrated plans of development for the hill areas.

13.2.3 As Himalayan hills do not constitute a homogeneous region, it is necessary to differentiate between the problems in each zone classified on the basis of climate, rainfall, topography etc. for formulating development programmes. The development of hill areas has to be planned within the framework of an articulated long term plan in which resource development programmes are adequately balanced by essential infrastructural facility, particularly communications and minimum social development programmes like drinking water. Provision of indoor employment opportunities in appropriate small scale processing and agro-industries and handicrafts should be accorded a very high priority in view of the long winter months in the hills. The reorientation of the development programmes from traditional patterns to those suitable for hill development requires a concentrated effort in research, investigation, survey and particularly, in formulation of viable projects. In the past, development efforts in hill areas were frustrated by project gap.

13.2.4 Any strategy for development in hill areas has to take note

of the economic constraints of the environment and try to maximise productivity directly by crop production and supplemented by suitable subsidiary occupations which the environment can support. The soils are liable to rapid erosion unless a complete vegetative cover is provided. A substantial part of the terrain is economically suited to, and ecologically requires, either a forestry programme or a pasture development programme. Cultivation of crop is possible only in the valleys and on terraced farms up a hill slope. Such land being limited, the most valuable crops should be grown which the ecology can sustain. The terrain can support horticulture for which even slopes can be used. The implementation of these programmes may impinge upon the present production pattern in which there is heavy reliance on the growing of foodcrops consumed by the local population. A change in the pattern of production to optimise economic return should, therefore, be followed by arrangements to provide foodgrains through controlled channel from other parts of the country as a national responsibility. However, in view of the transport and communication difficulties, production in the north eastern region should preferably be planned for food self-sufficiency.

13.2.5 Soil erosion being an important problem in the hill areas, soil and moisture conservation should be an important element in the strategy of development and include complete land management to ensure efficient use of soil. There is need to control shifting cultivation in the north eastern region and restore ecological balance by encouraging permanent cultivation and tree growth.

13.2.6 The hill areas offer scope for limited irrigation development through minor lift irrigation schemes and ground water utilisation, wherever feasible. Measures should be devised to ensure optimum utilisation of the irrigation water and all the farmers within the command of a kuh, as in Himachal Pradesh, should receive a share. Control measures like *warabandi* may be necessary. Apart from its limited potential, irrigation development is also more expensive in the hills but considerations of social return may allow a large expenditure. However, since the bulk of the hill area depends mostly on rainfall, the adoption of appropriate water harvesting, soil management and rainfed farming techniques becomes important. The hill streams offer scope for the generation of cheap hydroelectric power for local use. Power development should be an integral part of the hill area development programme to facilitate the establishment of several types of processing and manufacturing industries as also lift irrigation.

13.2.7 More work is required at the local level to determine the cropping pattern on the basis of agroclimatic suitability. In the limited area under food crops, the effort should be to secure a substantial im-

provement in yields for increasing the returns per unit of land as well as the availability. In order to improve the hill economy as well as for soil conservation, greater emphasis on horticultural development is necessary. The climatic conditions in the hills are conducive to the production of many types of cash crops. Production of cash crops like soyabean, sunflower, mushroom, hop, many temperate-climate vegetables and the production of seed of many temperate vegetables like cauliflower, beetroot and sugarbeet which do not produce seed in the plains need to be popularised in the northern hills. In the north eastern region plantation crops like tea, coffee and rubber should be encouraged in suitable areas. The hill areas provide good scope for floriculture. Production and marketing of floriculture should be organised and expanded. Research needs to be strengthened for the improvement of indigenous flowers. Orchid sanctuaries should be created on all the natural habitats and their exploitation regulated. Hill areas can specialise in aromatic and medicinal plants.

13.2.8 Livestock is an integral part of the life and economy of the hill population and acquires considerable importance in the growth and development of the hill economy. The strategy of development should include a well-laid out livestock programme and measures for the improvement of livestock for better yields and higher incomes for the farmers. In developing the livestock programme, the difficulty faced by the *Gujjars*, nomadic cattle breeders, in grazing their animals in forest areas and also in the disposal of milk should be removed. Their productive animals should be provided grazing facilities in the forests but under strict control. The milk plants at Almora and Haldwani should make suitable arrangements for the collection of milk from the buffaloes of *Gujjars*.

13.2.9 A successful milk production programme can be organised by taking up intensive programmes of crossbreeding of local cattle with exotic breeds. The crossbreeding programme should be supported by animal health cover to ensure its success. In the Himalayan region even pure bred exotic cattle can be raised provided adequate health cover ensured. Mithuns being important in some north eastern States, special investigations are required to explore the possibility of crossbreeding them with local cattle for increased milk and meat production and draught capacity. The crossbreeding programme has, however, to be supported by systematic fodder production and feed conservation programme as the cross bred animals require considerable care in management, feeding and housing. A programme of development of pastures with promising varieties of grass and fodder should, therefore, be taken up in the hill States, simultaneously.

13.2.10 Sheep rearing both for wool and mutton, is one of the

main occupations in the hill areas of Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir but the industry is not organised with regard to marketing, spinning and weaving. Sheep development, for which there is scope in the western and central Himalayas, should be organised in selected hill districts on the lines recommended in the Interim Report on poultry, sheep and pig production.* As sheep flocks are mostly maintained on migratory basis, the State Animal Husbandry/Sheep Department should set up service centres on the migratory routes and take up a systematic and integrated programme of shearing, grading and marketing of wool to alleviate the difficulties of the nomads.

13.2.11 Pasture development should be an important programme in the areas where sheep population is concentrated and cross breeding undertaken. Grazing in the pastures should be controlled according to the carrying capacity as the existing pastures are overburdened with excessive livestock population which is one of the important factors for the low productivity of the animals. More grazing areas should be identified, seeded, fertilised and brought in rotation.

13.2.12 Goat rearing is an important subsidiary occupation in the hill region but the browsing and acrobatic habits cause immense damage to growing plants. The number of goats must, therefore, be contained but their quality improved to get more milk and meat. Special programmes should however, be taken up for increasing the production of Pashmina in Ladakh region and Mohair in the hilly areas of Uttar Pradesh and Himachal Pradesh as both are in great demand for cottage industries as well as in the foreign markets.

13.2.13 There is scope for rapid development of piggery in the north eastern hills. An integrated development of piggery should be undertaken in these regions as recommended in the Interim Report on Some Aspects of Livestock Production in the North Eastern States. In other regions of the Himalayan hills, piggery development should be on the lines recommended in the Interim Report on poultry, sheep and pig production.

13.2.14 There is also good scope for the development of fisheries, for both commercial and sport purposes in view of the demand for fish from the local population and as an added attraction for tourists. In high altitudes cold water fisheries should be developed for these purposes. In low regions of the hills, ponds, tanks and *beels* need to be suitably reclaimed for developing culture fisheries of major carps with emphasis on better pisciculture practices. Collection of data in respect of ecological and biological conditions, hydrographic surveys of water

* The districts identified for milk, poultry, sheep and pig development are indicated in Appendix 13·1

areas suitable for pisciculture and training of fishermen in the techniques of cold water fisheries need to be organised.

13.2.15 Forests in the hills constitute an important wealth for the entire country. Forest wealth needs to be maintained not only for soil conservation and ecological balance but also for meeting the demand for wood and wood based products. There is need for an aggressive programme of production forestry in the hill regions and opening up inaccessible forests as recommended in the Interim Report on Production Forestry—Man-made Forests. In improving the quality of forests, the improvement of natural meadows should become a specific objective of the working plan of the Forest Department and it should be linked integrally with the requirements of intensive livestock development in the hill areas.

13.2.16 The scope for developing different kinds of sericulture like mulberry silk, *tasar* and *muga*, and improving honey yields in the hills should be exploited. The possibilities of taking up *tasar* culture throughout the oak belt of the Himalayas should be explored.

13.2.17 The utilisation of the production potential in the hills needs to be efficiently supported by the provision of collection, storage, marketing, processing and transportation. The production of fruits and vegetables should be in line with the pattern of internal and export demands. Depending on the market trends, a systematic changeover to different varieties of fruits as are best for marketing will require continuous assessment for planning production and marketing in future. Also detailed studies should be made on the problems of cold storage at the producing and consuming centres as an answer to the problem of a possible glut in the market. The impact of cold storage on the prices of fruits should be studied as these may give some lead to the fruit growers on the types of fruits that should be grown. The processing facilities should be developed in line with production by adopting an integrated approach linking up production and processing. Special encouragement should be given to the development of cottage wool and other home industries and crafts. In respect of forest products, apart from locating wood based industries, arrangements should be made for processing of various minor forest produce near the source of raw material and their proper storage and timely transportation for marketing.

13.2.18 Several other infrastructural facilities have to be provided for the development of the hill areas. Construction of roads, linking production centres and villages with the main roads, requires high priority to facilitate the movement of inputs as well as the products. In difficult areas the feasibility of even ropeways can be considered to ensure quick transit of the agricultural produce. A large produc-

tion programme in the hill areas will need adequate research backing. In order to initiate the hill farmers in the modern methods of production, extension education should be organised as an integral part of the development programme. The technical staff of all categories should be trained and oriented to the special problems of the hill areas. Keeping in view the communication difficulties, the area of operation of the technical staff should be so demarcated as to make intensive work possible and extension advice effective. The FSSs in the hill areas should have the areas of operation determined with due regard to constraints imposed by topography and terrain. Their technical staff stationed at the headquarters should have areas of their operation coterminous with the area of operation of the society.

13.2.19 The Western Ghat region has varying elevations and is generally a high rainfall area. Large areas are under forests and plantations like tea, coffee, pepper, arecanut and cocount. Paddy is generally taken in the valleys. Land capability is better exploited through a proper choice of crops that go well with the agroclimatic environment, but wherever attempts have been made to disturb the balance of cropping patterns, problems of serious soil erosion and low productivity have arisen. The heavy rainfall in the area results in severe erosion of fertile top soil and leaching of plant nutrients and impairment in soil fertility. It is necessary to evolve a cropping pattern appropriate to the hills which could help control soil erosion.

13.2.20 Keeping in view the agroclimatic conditions in the Western Ghats, the order of priority in the strategy of development should be forestry, plantation and livestock development.

13.2.21 The Western Ghats provide the only large areas of evergreen forests in the country. These areas are suitable for an aggressive programme of production forestry. The forest areas, particularly in Karnataka and Maharashtra, are also suitable for intensive fodder development to support a commercially viable animal husbandry programme.

13.2.22 The Ghat region is particularly suitable for raising plantation crops. In the upper reaches of these hills the accent should be on plantation crops and wherever irrigation is available, the area under plantation crops should be expanded in preference to other crops. But intensive work needs to be done to improve land utilisation under plantations, wherever possible. Low yielding plantation crops, particularly in small plantations, should be replaced by crops with high yield potential. The anomalies resulting from raising unsuitable varieties or from wrong siting of plantations should be rectified. In Malnad of Karnataka, an area programme could be developed for coffee cultivation. The possibility of pepper and rubber cultivation

in suitable areas should be explored. While the area under cashew plantations should be increased, such plantations in Kerala as are located in unproductive areas should be shifted to more promising ones.

13.2.23 Livestock rearing is widely practised all over the region as a subsidiary source of income by the farmers and the plantation labourers. While the area offers scope for rearing different categories of livestock, what is needed is specialisation of the activity to suit local conditions. There is considerable scope for developing milksheds in selected hill districts. The farmers may also be encouraged to rear crossbred heifers upto the age of weaning so that these can be supplied to the milkshed areas in the plains.

13.2.24 The hill regions is not very favourable for sheep development due to heavy rainfall and humid climate except in a very few areas. In such selected districts, sheep development should be taken up particularly for augmenting meat production. To support this programme, pastures should be developed at appropriate locations. Poultry and pig production should also be developed in the districts identified for the purpose in the Interim Report on poultry, sheep and pig production.

Tribal Areas

13.2.25 The development of hill regions will cater to the needs of the tribal communities living in these regions. But the tribal belt passing over central India and covering the States of Andhra Pradesh, Orissa, West Bengal, Bihar, Madhya Pradesh, Rajasthan, Gujarat and Maharashtra accounts for over 85 per cent of the total tribal population in the country.

13.2.26 Crop production, rearing of livestock and forests provide the main source of livelihood to the tribals although their economy is mainly subsistence oriented. The present state of backwardness in these areas is due to continuous neglect, over a long period, and lack of appreciation of their special problems, inadequate investment and non-integration of the tribal economy with the rest of the society. Lack of knowledge about improved methods of farming and management of soil and water, large scale land alienation and heavy indebtedness as well as the lack of infrastructural facilities and adequate organisational support are important deficiencies which have impeded the growth of the tribal communities. Extremely low level of literacy and prevalence of certain social factors have also contributed to the slow progress. Social unrest among tribals has lent urgency to the question of their socio-economic development.

13.2.27 The impact of the tribal development programmes under-

taken during the First, Second and Third Plan periods had been limited. The tribal development blocks initiated during the Second Plan did not have the desired effect due to a variety of reasons.

13.2.28 Appreciating the need for intensive development of the tribal areas, a special programme of tribal development agency was started, on a pilot basis, during the Fourth Plan in the States of Andhra Pradesh, Bihar, Madhya Pradesh and Orissa, each project having three components, namely, economic programme, roads programme and law and order. The economic development programmes constituting the core have been conceived on the lines of the Small Farmers Development Agency (SFDA), suitably oriented to the special needs of the tribal areas.

13.2.29 The working of both the tribal development blocks and the tribal development agencies has shown that the programmes for the welfare and development of the tribal people so far had a limited coverage. The programmes in the tribal development blocks became too rigid although different field conditions demanded different approach. The operational area of the tribal development agency also proved to be too small a unit for large investment in infrastructure for economic development and social services. A new pattern of integrated tribal development projects has, therefore, been evolved during the Fifth Plan. These projects are to be formulated for integrated programmes on a viable area basis. While retaining the project approach, the elements of the new strategy included prevention of exploitation, development of the tribal economy, generation of employment opportunities, provision of basic infrastructure and social attention to groups facing specific problems. Sub-plans for each State are being prepared with the long term objective of narrowing the gap between the levels of development of tribal and other areas.

13.2.30 Different tribals communities are at different stages of socio-economic development. Since the economy of tribals is based on crop production, livestock rearing, forests, fishing and hunting as well as handicrafts, the scope to develop each of these activities will have to be assessed in different project areas and the programme developed accordingly. In designing programmes, a distinction should be made between areas which are easily accessible and already exposed to market economy and those which are not easily accessible, lack market economy and have yet to be opened up.

13.2.31 Highest priority has to be given to the land problem. Immediate action is required to be taken to prepare reasonable and authentic land records and give rights to the tribals. Some rough and ready method has to be applied to expedite the process. Wherever tribals have cultivable lands and their rights have been recognised,

they should be helped with intensive programme of crop production. In the initial stages, production of foodgrains should be emphasised particularly in the interior areas. In areas which are close to the markets, production of cash crops could be emphasised depending on the market possibilities. The tribals practising shifting cultivation should be weaned away from it and permanently settled. Past deficiencies in land colonisation should be taken note of in developing the settlement programmes.

13.2.32 Debt redemption should be a priority programme. The project authority should set up itinerant courts which should decide both debts and land rights on the spot. Debts which are not liquidated should be paid off by the project authority from a suitable fund and treated as a loan to be recovered from the tribal family over a reasonable period through the agency of cooperatives. Arrangements should be made for the rehabilitation of the labourers freed from their bondage including settling them on land.

13.2.33 There is need for developing a symbiotic relationship between the forests and the tribals. The Forest Department should be fully involved in the planning and execution of tribal development programmes. It should establish processing units and the tribals trained for employment in these units. Forest Departments have a responsibility in the matter of creating employment for the tribal people through forestry programmes as indicated in Chapter 9.

13.2.34 In promoting livestock and poultry development programmes for the tribals, commercialisation of livestock production can be attempted in areas which have a market economy based on adequate measures for breed improvement, health cover and processing and marketing arrangements.

13.2.35 The traditional skills of the tribals for various handicrafts and village industries should be utilised. These should be identified and developed through necessary training.

13.2.36 The construction of arterial roads and link roads and opening up interior forest areas should constitute an important programme for tribal area development. An important element of the development programme should be extensive education as well as facilities for general education. In order to ensure that the development and educational programmes are properly implemented, it is necessary that only officers who are fully committed to the welfare of the tribal population are adequately trained and posted to these areas.

13.2.37 The present approach to the provision of credit, marketing and other services through a unified credit-cum-marketing organisation is in right direction. While expeditious coverage of the tribal areas under the cooperative structure is necessary, the primary societies

should, for the time being, be officially sponsored and managed, keeping in view the present level of development.

13.2.38 The development of the tribal areas will require multidisciplinary support for which coordination among various departments will be necessary. There should be a State level committee to ensure this support and to monitor and evaluate programme performance.

Arid and Semiarid Areas

13.2.39 Erratic rainfall and frequent crop failures and low productivity resulting from lack of appropriate technology and infrastructure have kept the arid and semiarid areas in the country at a low level of development contributing to regional imbalance. The deteriorating situation in these areas and the mounting burden of expenditure on drought relief measures led to the rethinking on the problems of development of these areas. A Rural Works Programme was undertaken during the Fourth Plan in 54 districts (along with some contiguous areas in another 18 districts) in 13 States which were chronically affected by drought. The objective was to create permanent works which would mitigate the effects of drought and also provide work to rural labour in such areas. The programme was later renamed as Drought Prone Areas Programme (DPAP) which covers substantially the hot arid areas and about 50 per cent of the semiarid areas which are considered drought prone.

13.2.40 The Drought Prone Areas Programme in the Draft Fifth Five Year Plan lays stress on the integrated area development to restore the ecological balance and to make the best use of the limited resources in the drought affected areas. The ultimate objective is to reduce, through proper technology, the severity of drought and scarcity condition and create a long term stable basis for production and employment. The programme lays emphasis not only on the reduction of imbalances but also on the amelioration of the condition of lowest three deciles of the population for whom special assistance is provided for. The Plan envisages the setting up of a coordinating corporate body charged with the responsibility of the design, coordination and implementation of the integrated programme of development in each drought prone district. A Central sector desert development programme, which was initiated in the Fourth Plan on pilot basis in four districts in Rajasthan, Gujarat and Haryana has been merged with DPAP during the Fifth Plan.

13.2.41 The identification of the chronically drought affected areas was made on the basis of factors like incidence of rainfall, environmental conditions like proximity to irrigated tracts providing superior

employment, availability of other avenues of employment in the same area, existence of schemes amenable to long term economic development and the frequency of famines or scarcity. The list of areas for DPAP need not be regarded as rigid and final. Since the factors are continuously changing, existing coverage of the programmes of DPAP should be reviewed from time to time in the light of future development.

13.2.42 The problems of the desert area being different from those in other arid and semiarid areas, a different set of measures are necessary for its development. There is urgent need to arrest the rapid deterioration of the desert area. In the Interim Report on Desert Development, a 15 year comprehensive and integrated programme has been recommended for its improvement and economic development with the accent on simultaneous attention to the development of water resources, forestry, animal husbandry and pastures. In the drought prone districts outside the desert area, development and management of irrigation is of special significance. High priority has to be accorded to the improvement of the existing irrigation works and completion of the projects under consideration. Also investigations into further possibilities of irrigation, both by surface and ground water, should be made and irrigation developed, wherever possible, on a priority basis. In addition, the possibility of diversion of water from other parts of the river basin or from other river basins to give a minimum support to drought affected districts should be examined on a priority basis. Such diversion should be viewed as a national requirement. In areas where irrigation improves substantially, the special programme of DPAP need not be continued. In view of the limited quantity of available ground water it should be equitably distributed by operating the irrigation source on cooperative or community basis. Water being scarce, the approach should be to maximise the return per unit quantity of water by growing crops requiring less quantity of water or by growing fodder in milkshed areas.

13.2.43 Planning on complete watershed basis should be an important strategy for the development of the DPAP areas. The improvement of the vegetative cover in the entire catchment areas including the hill slopes and uplands is essential for an integrated programme of soil and moisture conservation in these areas. Where irrigation facilities do not exist, the land use pattern should aim at reducing the area under arable cropping and increasing it under permanent vegetation. For providing fuelwood, timber and fodder as well as for soil and moisture conservation, an intensive programme of mixed forestry should be undertaken. Lands unfit for cultivation should be devoted to pasture development.

13.2.44 Research backing is essential for developing the technology of dry land farming and for formulating the cropping pattern appropriate for various soils and rainfall patterns. Where the present centres set up under the All India Coordinated Projects for Dry Land Farming do not cover all types of soils and rainfall patterns, additional centres should be opened for formulating the cropping patterns appropriate to such areas.

13.2.45 In the drought prone areas, livestock and poultry production provides a much more stable economic base than crop production. Due emphasis should therefore, be given to animal husbandry programmes in the development strategy. Appropriate measures are required to be taken for the improvement of breed and yields since the existing stock is mostly nondescript and poor yielder. A planned cattle development programme for milk and dairying should be undertaken in areas where irrigation is available and fodder production possible if such areas are within a milkshed. Milk collection and chilling centres and dairy products units can be established as part of the infrastructure. A number of DPAP districts have also possibility of sheep development, for both wool and mutton, as well as poultry and pig production.*

13.2.46 As development takes place along the desired lines, many agricultural products will be available for local processing and semi-processing. The scope for such economic activity needs to be assessed in each area and processing units located. The strategy for the growth of cold and semiarid areas, as in Ladakh valley in Jammu and Kashmir and Lahaul and Spiti Valleys and the Kinnaur region in Himachal Pradesh is yet to be properly evolved. A comprehensive research should be taken up early by the ICAR to provide the basis for formulating a viable economic development programme for these areas.

Kutch and Sundarban

13.2.47 The vast desiccated plain called the Rann of Kutch has special problems of development. The saline incrustations due to the ingress of sea water brought in by the tidal waves mainly during the monsoon have rendered this vast expanse of area uncultivable and uninhabitable except for a couple of islands in the Great Rann. The saline swampy soils require reclamation to make the region cultivable. Since a good portion of the Little Rann gets inundated by river waters, possibilities of reclamation are more in this area provided fresh or

* DPAP districts identified in the Interim Report for milk, poultry, sheep and pig production are shown in Appendix 13.2

low salinity water is available in sufficient quantity and suitable arrangements for drainage can be made. The broad conclusion emerging from earlier studies is that substantial area could be reclaimed and the problem of drinking water mitigated, if part of the Narmada flows could be diverted to this area. In this context, the feasibility of bringing the Narmada water to the Little Rann to control salinity for brackishwater fish culture can be considered. It is believed that in the shallow tidal backwaters, fish culture can be a possibility. A study in depth of the possibility of fish culture in the Little Rann may be taken up with a preinvestment survey in the selected area.

13.2.48 The entire area of Sundarban faces the problem of salinity, water logging and drainage. In the absence of upland water supply the area is exposed to tidal action making the water highly brackish. For the development of the Sundarban, an integrated programme simultaneously covering crop production, fisheries, animal husbandry and forestry and providing for improvement in infrastructural facilities including communication and supply of potable water will be necessary. For the protection and development of land and for increasing availability of fresh water for agricultural and drinking purposes, engineering and other measures as envisaged both in the Interim Plan of Development of the Sundarban and in the Sundarban Delta Project should be undertaken. Industrial development should be restricted to such agrobased industries as do not aggravate the problem of fresh water in view of its limited availability. As an integral part of the overall development of the region, river, road and rail transport facilities should be considerably improved. Electrification should be extended to the area to support development.

Small and Marginal Farmers and Agricultural Labourers

13.2.49 The basic principles for the development of these classes of population have been discussed in the Interim Report on Reorientation of Programmes of Small and Marginal Farmers and Agricultural Labourers Development Agencies. It has been recommended that an area development approach should be adopted by covering small and marginal farmers and agricultural labourers in each programme area and the distinction between the two programmes of Small Farmers Development Agency and Marginal Farmers and Agricultural Labourers Development Agency should be done away with. The main accent of the combined programme should be on improving the capability of farmers for increasing crop production. The coverage of the programme should be extended as much as possible to rainfed areas where the State should take up specific works of water harvesting, soil

conservation and land shaping on area basis.

13.2.50 Since farmers with very small holdings, particularly in rainfed areas may not be able to derive sufficient income from crop production, subsidiary occupation programmes should be superimposed in those programme districts which coincide with those suggested for special subsidiary occupation programmes in the Interim Reports on the subjects. The programme should be extended to 160 agency units in all, each unit covering preferably an area of a district and average of 70,000 families. The programme need not be extended to drought affected districts where a separate programme (DPAP) has been taken up.

13.2.51 Small farmers and marginal farmers with land holdings below 2 ha and one hectare respectively should be eligible for special assistance under the SFDA Programme. In irrigated areas a lower limit could be set. But in view of the special circumstances in the desert districts where the number of households having holdings below 2 ha may be relatively small, and even farmers having larger holdings who may not have sufficient income due to the nature of the local economy, the limit of land holdings for eligibility for special assistance should be kept flexible in order to bring a certain number under the special assistance programme. The minimum number to be covered under the special programme should be 20,000 cultivating and agricultural labourers households in these areas. Where the number of cultivating households having holdings of two ha and below is more, the existing definition should apply.

(Paragraph 13·2·10)

APPENDIX 13·1

Districts in the Himalayan Region and the Western Ghats Recommended for
Milk, Sheep, Poultry and Pig Development

State	Districts recommended for development of			
	milk	sheep	poultry	pig
1	2	3	4	5
HIMALAYAN REGION				
Jammu & Kashmir	1. Jammu 2. Kathua 3. Poonch 4. Rajouri	1. Jammu 2. Kathua 3. Anantnag 4. Baramula 5. Srinagar 6. Ladakh 7. Udhampur 8. Doda	1. Jammu 2. Kathua 3. Anantnag 4. Baramula 5. Srinagar 6. Ladakh 7. Udhampur 8. Doda	1. Sirmur 2. Simla 3. Kangra 4. Kulu 5. Kinnaur 6. Mahasu 7. Mandi
Himachal Pradesh		Sirmur	1. Sirmur 2. Simla	1. Sirmur 2. Simla

APPENDIX 13.1 (contd.)

1	2	3	4	5
Uttar Pradesh		1. Dehra Dun 2. Uttar Kashi 3. Chamoli 4. Garhwal	1. Dehra Dun	
West Bengal		1. Darjeeling	1. Darjeeling	
Arunachal Pradesh			1. Kameng 2. Subansiri 3. Siang 4. Lohit 5. Tirap	
Assam			1. Mikkir Hills 2. North Cachar Hills	
Manipur		1. Manipur North 2. Manipur South 3. Manipur East 4. Manipur Central	1. Manipur North 2. Manipur South 3. Manipur East 4. Manipur Central	1. Manipur North 2. Manipur South 3. Manipur East 4. Manipur Central
Meghalaya		1. Khasi and Jaintia Hills 2. Garo Hills	1. Khasi and Jaintia Hills 2. Garo Hills	1. Khasi and Jaintia Hills 2. Garo Hills
Mizoram				1. Mizoram
Nagaland		1. Kohima 2. Mukokchung 3. Tuensang	1. Kohima 2. Mukokchung 3. Tuensang	1. Kohima 2. Mukokchung 3. Tuensang

1. West Tripura

Tripura 1. West Tripura

WESTERN GHAT HIGH REGION:

Tripura	1. West Tripura
Maharashtra	
	1. Poona
	2. Satara
	3. Kolhapur
	4. Ratnagiri
Karnataka	
	1. Belgaum
	2. Shimoga
	2. Hassan
Kerala	
	1. Cannanore
	2. Quilon
	1. Chikmagalur
	2. Coorg
	1. Cannanore
	2. Khozikkode
	3. Palghat
	4. Trichur
	5. Ernakulam
	6. Quilon
	7. Trivandrum

APPENDIX 13.2

(Paragraph 13.2.45)
DPAP Districts Recommended for Programmes for Milk, Poultry, Sheep and Pig Production through Small and Marginal Farmers and Agricultural Labourers*

State	milk	poultry	sheep	pig
1	2	3	4	5
Andhra Pradesh	—	Kurnool	Kurnool	—
	—	—	Anantapur	—
	—	Cuddapah	Cuddapah	—
	—	—	Chittoor	—
	—	—	Mahboobnagar	—
Bihar	Nalanda	Nalanda	Nalgonda	Palamau
	—	—	—	—
	—	—	Monghyr	—
	—	—	Nawadah	Nawadah
	—	—	Rohat	—
Gujarat	Ahmedabad	Ahmedabad	—	—
	Banaskantha*	—	—	—
	Mehsana	Mehsana	—	—
	—	—	—	Amreli
	—	—	—	Bhavnagar
	—	—	Jamnagar	—
	—	—	—	Kutch
	—	—	—	Rajkot
Haryana	Bhiwani**	—	Rajkot	Surendranagar
	Hissar	—	Bhiwani	Bhiwani
	Rohtak	—	Hissar	Hissar
	—	—	Rohtak	—
	—	—	—	Mahendragarh

Jammu & Kashmir	—	—	Udampur Doda	—
Karnataka	—	Belgaum	Belgaum	Chikmagalur
	—	—	—	Bellary
	—	—	—	Bijapur
	—	—	—	Chitradurga
	—	—	—	Dharwar
	—	—	—	Gulbarga
	—	—	—	Kolar
	—	—	—	Trichur
	—	Tumkur	Tumkur	Tumkur
Maharashtra	—	Nasik	Nasik	Nasik
	—	—	Ahmednagar	Ahmednagar
	—	Poona	Poona	Poona
	—	Satara	Satara	Satara
	—	Sangli	Sangli	Sangli
	—	—	Sholapur	Sholapur
Orissa	—	—	—	Kalahandi
Rajasthan	—	Bikaner Ajmer	Bikaner Ajmer	Bikaner Ajmer
	—	—	—	Bamer
	—	—	—	Churu
	—	—	—	Dungarpur

APPENDIX 13.2 (contd)

1	2	3	4	5
Tamil Nadu	.	.	Jaiselmer	—
	—	—	Jalore	—
	—	—	Jhunjhunu	—
	—	—	Jodhpur	—
	—	—	Nagpur	—
	—	—	Pali	—
	—	—	Udaipur	—
	—	—	Dharmapuri	—
	—	—	Ramanathapuram	—
	—	—	Allahabad	Allahabad
Uttar Pradesh	.	.	Varanasi	—
	—	—	Mirzapur	—
	—	—	Bankura	Bankura
	—	—	Midnapur	—
	—	—	Purulia	Purulia

* 1973. Interim Report on Poultry, Sheep and Pig Production through small and Marginal Farmers and Agricultural Labourers for supplementing their income. National Commission on Agriculture, * New Delhi.

** New districts carved out are: Nawada from Gaya; Rohtas from Shahabad, and Bhawani from Hissar. the Interim Report refers to the programmes in Gaya, Shahabad and Hissar.

PLANNING, STATISTICS AND ADMINISTRATION

1 PLANNING

14.1.1 Soon after Independence, economic planning was adopted as a principal policy for development of the National economy. Agriculture, together with irrigation and infrastructure, has received priority in all the plans, though there have been shifts in emphasis, as between agriculture and other sectors of the economy in the overall scheme of development. The major objective of agricultural development under the successive five year plans have been (a) achieving self-sufficiency in foodgrains; (b) increasing agricultural production to meet the needs of industry and exports; (c) diversifying the rural economy with stress on animal husbandry, dairying and fisheries; and (d) improving the levels of living of the farm community. The experience of planning in the field of agriculture during the last twentyfive years, however, suggests some urgent and essential organisational and directional changes in the planning process, and a reorientation in the outlook of the planning machinery at different levels.

Approach to Agricultural Planning

14.1.2 In India, plan formulation starts from above with a view to balancing investments, overall and sectoral, with available resources, internal and external. The programmes are built up at the State/district level within the constraints indicated by the Central planning authorities. A more decentralised planning process would, however, facilitate optimum use of regional resources. Since the programmes for agricultural development are best planned on the basis of agroclimatic regions or watersheds or sometimes even the local development profiles, the approach has to be one of planning from below to make the plans and programmes more realistic and feasible, and enable optimum utilisation of resources available locally. An indication of the resources, however tentative, likely to be made available from above would facilitate this task and bring about a greater degree of flexibility and realism.

14.1.3 Agriculture being an individual enterprise, unless the village community is made to participate in development programmes, any

effort for agricultural planning from above is likely to bypass the actual producer. The involvement of the village community may be secured through a development plan based on scientific agriculture, which can give benefits to all sections of the community. The whole village development, as postulated in the Interim Report*, should be tried on a pilot basis, since the required leadership may be difficult to come by if the programme is tried on a large scale. This concept of village planning requires a strong and devoted leader who can counter initial reaction of the vested interests to the programme of social justice inherent in it.

14.1.4 Alternatively, the plan based on an area approach, taking the village as the nucleus and developing it into a large watershed, should be tried. Farmers' participation in such a plan has to be mobilised by the agricultural extension organisation with necessary help from other field organisations. The farmers' service societies, referred to in Chapter 12, can deal with both credit problems on an area basis and provide a responsible extension organisation for the benefit of small and marginal farmers, whose needs have to be met for the success of this approach.

14.1.5 While agricultural schemes and programmes can be built up from below, wherever necessary and feasible, planning in the real sense should be done at the district level. At this level, there should be an effective setup, both for drawing up integrated plans and budget for agricultural development and for coordinating the implementation of programmes at the field level. The setup has been further discussed in section 3 of this chapter. However, watershed and regional aspects should receive due attention and the planning efforts at these levels, in regard to both formulation and implementation, and should be effectively coordinated with such efforts at the district and State levels.

14.1.6 The approach to agricultural planning will be different as between rainfed and irrigated areas. Broadly, there has to be a regional approach in rainfed agriculture supplemented by an individual approach to irrigated areas in the region. While for detailed planning district is the effective unit of planning for agricultural production, for irrigated agriculture the unit would be the command area. There has to be a close coordination between district units, where the planning unit extends beyond a district.

Planning Process

14.1.7 Plans are formulated through a process of iteration and a series of consultations in study/steering/working groups, both at the Central and State levels, keeping within the framework and guidelines

*March, 1973 Interim Report on Whole Village Development Programme, National Commission on Agriculture.

laid down by the Planning Commission. There should be a closer co-ordination and understanding on methodology and approach and basic assumptions for formulation of plan proposals among the various working groups at the Centre and in the States. There should also be a greater involvement of representatives having field experience from States as well as from non-officials like agricultural economists, scientists and progressive farmers in these working groups.

14.1.8 The procedure for formulation and administrative approval of Centrally sponsored schemes needs to be simplified. Large discretionary powers should be given to the Ministry of Agriculture and Irrigation in issuing administrative approval and sanctions to a number of Centrally sponsored schemes. The State Governments should also be given freedom to adjust the details within the broad objectives of the model schemes.

14.1.9 The plan proposals prepared without due regard to the limitations of the financial resources have often to be pruned to fit in with the available resources. In the process, important schemes sometimes get lower allocations and there is the possibility of plan priorities getting distorted when pruning is considerable. In order that agricultural plans are based on realistic assumptions, it is necessary to assess the total financial resources likely to be available for agricultural development in the form of plan allocations and committed non-plan funds and those from institutional resources.

Plan Implementation

14.1.10 Proper and timely implementation of the plans is of utmost importance in the planning process. Plan schemes should be drawn up in sufficient detail so that they could be taken up as soon as the plan is approved for implementation by the concerned authorities. Greater decentralisation of powers and delegation of authority are necessary for effective implementation of plan projects. A careful review has to be made of the current procedures and, as far as possible, the power of decision-making should be decentralised.

14.1.11 An effective evaluation system is essential to keep a watch on the progress of schemes, and for keeping the implementation agencies adequately, and promptly, informed about their problems. An advance warning in respect of the areas where potential bottlenecks or shortfalls are likely to arise, would enable adequate and timely remedial measures. Suitable information and reporting systems need to be evolved so that those responsible for implementation could anticipate difficulties and judge the progress and performance of these programmes in relation to predetermined targets, with a view to taking

necessary corrective measures.

14.1.12 Apart from evaluation and appraisal of projects by Government departments, evaluation through independent autonomous bodies like agricultural universities and research institutions should be encouraged. The present system of periodic reviews at the Centre in respect of Central and Centrally sponsored schemes should be supplemented by integrated sectoral reviews as well as reviews of the total agricultural sector with the support of the proposed evaluation units.

Planning Machinery

14.1.13 For efficient planning and implementation, well organised planning units will be necessary at the Central, State and district levels. The planning set-up at the district level should be mainly responsible for : (a) translating the policy directives from the State or even the Central level into suitable action programmes; (b) fixing detailed targets and standards of performance; and (c) progress analysis, supervision and coordination of the implementation of programmes.

Methodological Problems

14.1.14 Since the demand projections constitute the starting point in any forward looking exercise, it is necessary to constantly review and improve upon the methodology adopted for projection of demand over a perspective period. Apart from economic considerations, such as attaining desirable and feasible nutritional diet, changes in the tastes and preferences have also to be taken into account in making these projections.

14.1.15 The targets for agricultural commodities are fixed in terms of additional potential expected to be created during the plan period. The yardstick approach utilised for estimating the production potential has been one of the weakest links in agricultural planning. Since the yardsticks used for estimating the targets were not the correct indicators of the actual input responses under actual field conditions, the production targets so estimated were not realistic. A careful assessment of the production potential has to be made in respect of different agroclimatic regions, and the conditions in different regions analysed for improvement of biological productivity. Even within the same agroclimatic region there are differences in productivity, which require a careful appraisal for completely restructuring cropping patterns on agroclimatic and other considerations with a view to achieving

optimum yield levels of biological productivity.

14.1.16 Till such time that adequate data base becomes available for making the appraisal, the use of existing yardsticks is inescapable. In order to be more meaningful, the yardsticks should be fixed separately for relatively homogeneous groups of farms, or, at least, relatively homogeneous agroclimatic regions. These should be reviewed at the end of each plan period to take into account technological changes that have occurred during the period. The concept of yardstick and production potential should be extended to animal husbandry and fisheries sectors.

14.1.17 Specific targets of production should be indicated down to the district/project level, which is the crucial level of plan implementation. Since the responses to agricultural inputs vary from area to area depending on a variety of both controllable and uncontrollable factors, targets of production in respect of essential commodities might be fixed not merely in terms of a single figure of final output but also in terms of a range of output or aggregate output during the plan period.

14.1.18 It would be necessary to improve the data base for formulating plan proposals and targets. Material balances provide the rationale for fixing output targets of principal commodities in the plan. Input-output tables are used to establish the balance and consistency of the plan at the aggregate level. The detailed data used in the input-output tables and the technical coefficients should be published on a regular basis. In rapidly changing technological situations such coefficients should be brought up-to-date at five-year intervals.

Regional Planning for Balanced Development

14.1.19 The intensive approach to agricultural development, adopted since the early sixties and exemplified in area specific programmes like IADP, IAAP and HYVP, though had the logic of expediency, led to aggravation of regional imbalances. The continuance of the selective approach to agricultural development tended to aggravate rather than reduce the inter-State differences. The objective of agricultural development planning should not merely be maximising production in overall terms but include considerations of regional balance, economic stability and growth with social justice.

14.1.20 An essential prerequisite of regional agricultural planning is the classification of the country into agroclimatic or agricultural regions. It would be useful to consider homogeneous regions for planning and formulating programmes for developing the likely potential. In the ultimate analysis, regional planning may be substantially district planning and as such, the detailed work of plan formulation would

essentially have to be done by the district planning cells. Where a region covers two or more districts, a coordination committee can deal with the problem on an ad-hoc basis. The regional agricultural development plans would also have to be tied up with the framework of overall national planning.

14.1.21 As each backward area represented a unique combination of factors, no uniform programme of development could be successfully conceived and imposed from the national level. The evolution of appropriate location specific strategy, based on a careful identification of the causes of backwardness as well as the potential for development, is an essential prerequisite for accelerating development. Appropriate techniques for regional planning should be developed to minimise the possible conflict between the criteria of efficiency and equity.

14.1.22 Identification and removal of inadequacies in the matter of infrastructural development is basic to the development programmes for backward regions. Infrastructure development programmes have to conform to a long term policy within available financial resources. Since any time-lag between the infrastructure development and programme development may make the infrastructure infructuous, it is important that both are taken up simultaneously.

14.1.23 In areas where the potential for crop production is low, there is need for introduction of programmes in the fields of animal husbandry, poultry, fisheries, horticulture, social forestry etc. for the benefit of the weaker sections of the population.

14.1.24 The growth possibilities in various regions within a State, and the need for a change of strategy to get the maximum advantage in the region, could best be analysed and formulated at the State level. The State agricultural planning cell should undertake detailed perspective planning for the various agroclimatic regions in the State with the help of agricultural universities and other scientific organisations and technical departments, which can assist in formulating a detailed plan. The district planning cells then have to examine how far under the socioeconomic conditions prevailing in the district and in the existing state of infrastructure the changes postulated can be carried out and in what time-frame. The planning cell at the State level should build into the State plan the necessary correctives on the basis of the feedback by the district cells about existing infrastructure and socioeconomic constraints. The problems, which cannot be resolved at the State level, will have to be referred to the Planning Division in the Ministry of Agriculture and Irrigation for examination in the perspective of the national plan.

14.1.25 Apart from planning for development of agricultural

resources in various agroclimatic regions, there is a pressing need for infrastructural planning for maximising production and productivity. Planning of certain aspects like irrigation, communication, marketing and socioeconomic changes has to be done at the macro (national) level. Water use planning and the development of a suitable infrastructure, therefore, has to be done at the State and national levels. Increasing the productivity of backward areas requires national planning of communications, both road and rail. Exploitation of areas for marine fisheries has to be nationally planned for maximising productivity.

14.1.26 The detailed work of regional planning would involve intensive training in the analysis of available data, identification of constraints on development etc., and would also call for interdisciplinary coordination between the scientists and planners in the relevant fields. This work should also be undertaken under the auspices of the planning units at different levels.

2 STATISTICS

14.2.1 Out of the total geographical area of 328 Mha, land use statistics are available for 306 Mha. Bulk of the 'nonreporting' area is accounted for by the area under the illegal occupation of Pakistan and China, for which no data become available, and the rest by hill tracts of north eastern States and small pockets in other States. With the help of aerial photographs already available, copied with topographical survey on the ground, the coverage of agricultural statistics should be extended to the entire geographical area of the country by 1978-79 at the latest.

Land Utilisation and Area under Crops

14.2.2 Of the total reporting area, estimates for 81.7 per cent are based on complete enumeration, 9.2 per cent on sample surveys and those for the remaining areas on conventional methods or on impressionistic estimates by village headmen, chowkidars and superior revenue officials. In areas which are cadastrally surveyed and where the Patwari agency exists, the estimates of land use and area under crops are based on the crop inspections done by the Patwaris. As a system, this is the best, provided the basic records are maintained properly by the revenue agency. The association of Patwari with the land records and agricultural statistics brings to bear upon the system of collection the authority and prestige that is associated with the revenue agency in the villages. However, in actual practice, due to several reasons,

including large geographical jurisdiction, increased responsibilities and functions during the recent years and also due partly to indifference and inadequate supervision, inaccuracies in the recording of crop areas and delays in submission of returns have taken place.

14.2.3 The only way to improve the basic structure for agricultural statistics is to enable the Patwari to do his job better and also ensure that the Patwaris and the Revenue Inspectors at higher level devote adequate attention to the collection of agricultural statistics and give top priority to the work specially during the periods of crop inspection. For ensuring this, measures such as reduction in the Patwari's jurisdiction to a manageable area and intensive supervision through departmental and statistical staff are necessary. Immediate steps should be taken to establish the reporting agencies in the States of West Bengal, Orissa and Kerala with a view to enabling the collection of basic agricultural statistics on a complete enumeration basis. Arrangements should be made for imparting refresher training to the Patwaris and Kanungos in the detailed concepts and definitions. The States should also adopt the revised forms and concepts and definitions, recommended by the Committee on Improvement of Agricultural Statistics, and ensure that these are followed by the primary agencies.

Statistics of Crop Production

14.2.4 At present, crop estimates are issued for 37 field crops besides the plantation crops of tea, coffee and rubber, for which the relevant estimates are prepared by the respective Boards. New crops, introduced as a result of technological progress should be included within the scope of crop estimation system as and when their cultivation becomes fairly extensive.

14.2.5 The statistics of crop yield are obtained largely (about 95 per cent of production of cereals and 66 per cent of pulses) by the method of random sample crop-cutting surveys organised by the States under the overall technical guidance and control of the National Sample Survey Organisation (NSSO). As a method, crop-cutting surveys based on random sampling technique is sound but in actual implementation deficiencies have cropped up even in regard to the crop-cutting experiments. Steps should, therefore, be taken to review the sampling design adopted for crop-cutting surveys with a view to adopting the stratification according to irrigated and rainfed areas and according to high yielding varieties and local varieties of crops.

Reliability of Estimates of Foodgrains Production

14.2.6 From the methodological point of view, the methods cur-

rently adopted in India, viz., complete enumeration for area and random sample surveys for yield, are the best. By convention, the estimates of crop production published by the Government of India are merely aggregates of figures received from the States. However, for the three years 1967-68 to 1969-70 an assessment of weather and crop conditions, progress of programmes of agricultural development, pace and pattern of market arrivals and price situation showed that the estimates of foodgrains production reported by some of the States had a substantial element of underestimation. This is mainly because, in most of the States, till recently, there was no provision for recording of areas under short duration varieties of crops grown in summer season, particularly rice. Also irrigated areas and areas under high yielding varieties are not adequately reflected in the samples actually selected for crop-cutting surveys in some States. There is also nonresponse in terms of experiments planned, but not conducted. Keeping in view these factors, the Directorate of Economics and Statistics (DES) revised the estimates reported by some States upwards, the magnitude of upward revision in the different years varying from 2.7 to 7.7 per cent. However, the estimates of consumption requirements for these years, arrived at on the basis of net availability of foodgrains in 1973-74 and by proceeding backwards after taking into account the composite effects of changes in population, per capita real incomes, levels of prices of foodgrains in each of the years, showed that the estimated figures of gross production based on consumption were nearer the Central Government's adjusted estimates; in fact, they were even higher in some cases, confirming the Central Government's contention that the State figures in many cases were grossly underestimated. The estimated gross production of foodgrains based on the estimated consumption, the estimates issued by the Central Government and those reported by the States are given in Appendix 14.1.

14.2.7 In order that, in future, better estimates are made available by the established agencies, suitable measures should be taken for improvements in the design, methods of collection and scientific compilation and estimation and also due attention paid to the implementation and supervision of the techniques as adopted in the field.

Improvement of Crop Statistics

14.2.8 To be useful for planning and formulation and implementation of policy, the statistics of crop production should be available on time. In order to reduce the time-lag between the sowing and harvesting of crops and the availability of estimates of area and production respectively, a Centrally sponsored scheme for Timely Reporting of

Estimates of Area and Production of Principal Crops (TRS) was initiated by the Ministry of Agriculture and Irrigation in 1969-70. Under this scheme, which is in operation in 13 States, the villages in each stratum (tehsil/revenue inspector circle) are divided into five independent nonoverlapping sets and the Patwari is expected to do the crop inspection in one-fifth of the villages in advance of the period prescribed for such inspection and send the abstracts to the State headquarters through his immediate superiors. The TRS provides for recording the area under irrigation and high yielding varieties in the selected villages. In the case of States like West Bengal, Orissa and Kerala, where village revenue agencies do not exist, it is proposed to introduce a miniature TRS by having field-to-field enumeration of crops in all the three crop seasons in about 10 per cent of the villages. The TRS should be extended to all the States by 1976-77. There should be constant Central supervision to ensure the quality of the field and supervisory work done in the States under the TRS.

14.2.9 A scheme for Improvement of Crop Statistics, drawn up by the NSSO and the Ministry of Agriculture and Irrigation in consultation with the Commission, provides for a sample check of area enumeration and crop-cutting experiments in about 5,000 sample villages by the NSSO and in an equal number of villages by wholetime State supervisory staff. Crop-cutting experiments are conducted in a subsample of the villages selected for the TRS for inspection. About 30,000 crop-cutting experiments are inspected at harvest stage spread over foodgrains and commercial crops. There is exchange of results between the Central and State agencies and each agency is required to undertake an analysis of the sample checks of the cropped area and crop-cutting experiments in respect of both the sets of supervised villages.

14.2.10 One advantage of the new scheme is that the data available from the TRS and the results of the supervised samples can be utilised for preparing advance estimates of area and production of principal crops. The final estimates of production will, however, be based on the data furnished by the States; but where there are wide differences between the figures of area based on complete enumeration and those based on supervised sample, the nature of the differences will have to be examined with a view to evolving objective procedures for making selective use of the supervised data. A Technical Working Group is examining the results of sample check thrown up by the 1973-74 survey with a view to determining the modifications necessary in the design of the sample, sample size and the estimation procedures in order to build up reliable estimates at the State level.

14.2.11 There are a few other problems such as reporting of area under mixed crops, recording of area under summer crops etc., which

need attention. Each State should review at the district level the sowing and harvesting seasons of different crops in consultation with the District Agricultural Officers and revise the periods of crop inspection, where necessary, in the light of such review. In the case of crops like cotton, tobacco, pepper and cashewnut, where there are differences between the estimates put out by the trade and the official agency, steps are necessary to reconcile the two sets of figures.

14.2.12 For obtaining advance estimates of area and production, it would be desirable for the DES to get periodical reports on season and crop conditions from each block from the Block Agricultural Development Officers, and the Chief Agricultural Development Officer at the district level, and on this basis prepare qualitative reports to start with, which could be later developed into advance estimates of crop production in quantitative terms. The possibility of developing advance estimates of crop production on the basis of biometric measurements of the crop during its growth is being studied by the IARS through pilot investigations in respect of paddy, wheat, jute and cotton. The scope of these investigations should be extended to other crops and the results utilised on a field scale as soon as the requisite techniques are evolved. The Committee on Improvement of Agricultural Statistics should be activated and made to meet more frequently not only to consider new proposals for improvement of agricultural statistics but also to review the action on its recommendations from time to time.

14.2.13 New scientific techniques of remote sensing through artificial satellites are being tried in several countries for various purposes such as resource surveys, pest surveillance, advance warnings on impending crop failures and even crop estimation. In India, remote sensing through aerial photographs is being tried in Anantapur district on an experimental basis by the ICAR in collaboration with the Indian Space Research Organisation (ISRO). While the new techniques have potentialities for some purposes, and even in providing an early warning of impending crop failure on a broad regional basis, their use in crop estimation in replacement of the existing methods seems to be limited under the Indian conditions. The DES should, however, keep in touch with developments in the field.

Fruits and Vegetables Statistics

14.2.14 Statistics of area under different fruits are now available at the all India level from 1958 onward for mangoes, citrus, banana, grapes, pome and other fruits among fresh fruits, and cashew-

nut among dry fruits. In addition, estimates of area under papaya and banana and their production based on eye estimates are also published by the DES. With regard to vegetables, separate figures of area are available for potato, tapioca, sweet potato, onion and all other fresh vegetables taken together. Estimates of production are available only for potato, sweet potato and tapioca.

14.2.15 In considering the problems of collection of statistics of area and production of fruits and vegetables, the agricultural statistics authority in each State should, in consultation with the Director of Agriculture/Horticulture, prepare a list of important fruits and vegetables grown in the State. Arrangements should be made for collection of information regarding area under each of the important crops in the normal agricultural statistics on the basis of complete enumeration done by the Patwaris. A census of fruit trees (including scattered trees) should be conducted once every five years throughout the country to provide a sound basis for future planning, and also to serve as a reliable frame for conducting sample surveys on different aspects of fruit cultivation. The methodology, already evolved by the IARS for estimating the yield rates and production of fruits, should be adopted by the States for undertaking sample surveys for one or two crops every year in rotation in accordance with an all India programme. For vegetables, pilot investigations should be conducted by the States and the IARS in important vegetable growing areas.

14.2.16 To collect data on prices and arrivals of fruits and vegetables, wholetime staff should be posted in all the important city fruit markets. Ancillary data on cold storages, stocks, marketing, practices, movement of fruits and vegetables by different modes of transportation etc. should also be collected at regular intervals. Methodological surveys should be carried out to standardise the data collection techniques for estimating the cost of production of fruits. Statistical units should be set up in the States to look after the work of horticultural statistics. For coordinating the data collection at the all India level, and for bringing about improvements in the techniques, a separate unit should be set up in the DES.

Irrigation Statistics

14.2.17 Statistics of irrigation comprise mainly data on area irrigated by different sources and that under crops irrigated. The main defects in the irrigation statistics are : (a) time lag in the availability; (b) lack of uniformity in concepts and definitions of terms like 'irrigation potential' and 'irrigation intensity'; (c) discrepancy

between the data based on land utilisation statistics (LUS) and those derived from the progress reports; and (d) their inadequacy to meet the requirements of planning and evaluation of progress. The proposals given in Appendix 14.2 in this regard should be uniformly adopted.

14.2.18 The gross irrigated area in the Indian Union went up from 22.6 Mha in 1950-51 to 38.6 Mha in 1971-72. On the other hand, the additional area receiving irrigation benefits during this period, as per progress reports, is 27.65 Mha including 8.06 Mha from major and medium irrigation and 19.59 Mha from minor irrigation schemes. The difference between the two figures is large. While attempts at reconciliation of the two sets of figures have been made in the past, this reconciliation should be done at the district level where statistics reported in the LUS can be checked with the corresponding figures of additional irrigation benefits from different schemes.

14.2.19 For improving the utility of irrigation statistics, the following more rational classification of sources of irrigation should be adopted :

I Surface Water

Public surface water flow irrigation projects

- (i) tanks
 - (a) large
 - (b) small
- (ii) major & medium
- (iii) minor

Public surface water lift irrigation projects

- (i) major & medium
- (ii) minor

Private surface water irrigation works

- (i) flow irrigation
- (ii) lift irrigation

II Groundwater

- (i) public tubewells
- (ii) private tubewells
- (iii) dugwells.

A census of irrigation sources should be undertaken along with the Agricultural Census once in five years. There is also scope for improving the statistical coverage of the Annual Administration Reports

prepared by the Irrigation Departments and these data should be consolidated at the all India level and published every year. For handling the collection and analysis of irrigation statistics, there should be appropriate statistical units in the State Departments of Irrigation, and there should be close coordination between this statistical unit and the Statistician incharge of agricultural statistics in the State.

Livestock Statistics

14.2.20 Basic statistics in the sphere of animal husbandry comprise data on number of different categories of livestock, including poultry, their composition in terms of breeds, sex and age, and the output of different livestock products and by-products. The statistics of number of livestock are based on the quinquennial livestock censuses. The last census, which was due on April 15, 1971 was postponed by one year, but even then could not be taken uniformly in all the States at that point of time. It is important that the livestock census should be undertaken simultaneously in all the States and Union Territories. Further, the practice of having a post-enumeration check by an independent statistical agency in addition to the rationalised supervision by State agencies should be revived. Advance tabulation of 10 per cent sample of the livestock households in respect of the more important items should be undertaken with a view to bringing out advance reports on the census results within a few months of its completion. State reports and the all India report giving estimates of livestock population should be available within one year of the completion of the census.

14.2.21 The IARS has been engaged in evolving a suitable design by undertaking integrated surveys for obtaining estimates of output of livestock products and numbers of various categories of livestock spread over a period of five years. The intention is that every year one main livestock product should be selected and studied sufficiently intensively so that reliable information on the number of animals and the output of the product, together with related information on feeding and other animal husbandry practices associated with species, is collected. In the other years only indices of change in the numbers and output in relation to the base year would be worked out. The concept of the integrated survey is sound in principle and the methodology should be finalised quickly. Till then, the existing sample surveys for different livestock products should be continued. Further, a system of periodical release of all India and State estimates of livestock production should be introduced as soon as practicable.

14.2.22 Data on wholesale and retail prices of livestock products

and livestock feed and fodder should be collected at selected centres on a weekly basis. The information on marketing aspects of livestock products need to be brought upto date by the Directorate of Marketing and Inspection (DMI), which should carry out fresh marketing surveys.

14.2.23 The Livestock Statistics Unit in the Animal Husbandry Division of the Ministry of Agriculture and Irrigation should study the nature of data at present being maintained in the dairy and other plants for their own normal administrative purposes and prescribe standard proforma through which this information could be collected, compiled, tabulated and analysed at the State and all India levels.

14.2.24 Apart from the regular statistical information, there is also need for developing a system of reporting, on quarterly basis, information on livestock situation in the districts, dealing with prevailing conditions relating to season, climate, incidence of disease, availability of animal feed and fodder, price situation in respect of livestock and livestock products etc.

14.2.25 For collection of comprehensive data on livestock, the Animal Husbandry Officer at the district level should have the help of requisite computational and other staff. At the State level, the Director of Animal Husbandry should have a fullfledged statistical division under a Senior Statistician, not below the rank of a Joint Director (Animal Husbandry). The Division should consist of three units, namely, Assessment Unit, Analytical Unit and Livestock Census Unit, each under the charge of a professional Statistician. For economic analysis of the various projects and for undertaking evaluation studies in the State, an economist of a suitable rank should be provided in the division. The major dairy plants should also have economists on their staff to render advice on the pattern of rational conversion of milk into various products. At the Central level, the statistical work should continue to be coordinated by the Statistical Unit in the Animal Husbandry Division in the Ministry of Agriculture and Irrigation, which should be considerably strengthened. At this level also, there should be an economist at Joint Director's level for undertaking evaluation and cost-benefit studies. Methodological research should continue to be undertaken by the IARS and agricultural universities.

Fisheries Statistics

14.2.26 No precise estimate of potential fisheries resources is available. With regard to inland and estuarine fisheries, reliable

figures of estimated annual catches are also not available. The pilot investigations for estimation of the catches including those from captive fishery resources should be completed early and appropriate methodology should be made available to the State Governments for implementation.

14.2.27 For marine fisheries, both CMFRI and some of the States carry out sample surveys, which give the estimates of catch. In view of the discrepancies between the two sets of estimates, which will persist as long as the two surveys are carried out independently, the Fisheries Division at the Centre should discuss the possibility of having an integrated sample survey so designed as to provide annual all India estimates with a reasonable degree of precision, say 2 per cent. The primary enumerating staff may belong to the State Departments of Fisheries. In addition to the State supervision, the statistical staff of the CMFRI could be used to supervise the sample surveys conducted by the States and collect biometric data. Such an integrated scheme would, besides improving the reliability of the data, avoid a situation in which Centre and the States give two different estimates of production.

14.2.28 Data on fishermen population, fishing craft, tackle and nets, inland water resources, biological and research statistics, prices etc. should be collected regularly. The census of fishing craft, tackle and nets should be separated from the livestock census, and should be conducted by the State Fisheries Departments under the overall technical guidance and control of the Statistical Unit in the Fisheries Division of the Ministry of Agriculture and Irrigation. For planning the development of inland fisheries, it is necessary to have a critical assessment of the resources periodically, specially with reference to geographical, physical, chemical and biological factors. A continuous resource survey is also necessary with regard to marine fisheries to collect information on various biological characteristics such as growth, recruitment, mortality, measurement of lengths, age determinants, etc.

14.2.29 A registration of small mechanised boats of size below 25 gross registered tonnage (GRT) would be useful for maintaining statistics as also for keeping a watch on the growth of mechanisation. The information relating to operational details and performance of the larger vessels above 25 GRT should be collected and analysed systematically for working out the economics of deep sea fishing and for demonstrating its potentialities.

14.2.30 Data on production of spawn, fry and fingerlings, both private and departmental, should be collected and appropriate technical coefficients such as mortality at various stages of fish growth etc.

should be developed. Information on producers' wholesale and retail prices, market arrivals, quantity of fish stored in cold storages, utilisation of fish and processing should be collected at periodical intervals.

14.2.31 For proper development of fisheries statistics, every State should have a strong statistical unit in the Fisheries Department manned by qualified statisticians to deal with all aspects of fisheries statistics. At the Central level also, the Fisheries Statistics Unit should be strengthened and placed under a Joint Director. For economic analysis of the various projects and undertaking evaluation studies, economists should be added to the Fisheries Statistics Units at the Central and State levels. The Statistical Units in the Central fisheries institutes like the CMFRI, CIFRI and CIFT should also be strengthened to undertake larger responsibilities.

Forestry Statistics

14.2.32 Though the coverage of forestry statistics has been gradually extended, the available data do not fully meet the needs of planning. Even with regard to area under forests, there is a considerable difference between the total area as given by LUS (66.0 Mha in 1970-71) and that reported in Indian Forest Statistics (74.8 Mha). The differences are large in some of the States. It is necessary that at the State level, the Chief Conservator of Forests and the crop reporting authority should take steps to eliminate the differences. The reconciliation may have to be attempted at the district level also.

14.2.33 With regard to classification of forest area, according to species, while the State Governments may adopt a more detailed classification for their use, the data may be collected on a uniform basis so that compilation at the all India level becomes possible. Statistics, according to functional classification, namely, protection forests, production forests and social forests, should also be collected.

14.2.34 With regard to outturn, the basic defect in the available data on forest produce is that they relate only to the forests under the control of State Forest Departments, who report the data with regard to authorised removals only. Suitable procedures have to be devised to frame estimates of unrecorded production through surveys or otherwise, at least once in five years. The possibility of collecting data on timber and fuelwood from agricultural lands through the periodical Agricultural Censuses should be examined. There is also need for verifying the figures of forest produce removed by the contractors, through sample check. For ensuring inter-State uniformity and correct estimation of the contribution of forestry sector to

national income the concept of value of outturn should be defined so as to relate it to the value at the first point of sale by the Forest Departments.

14.2.35 For price data, wholesale prices of major and minor forest produce should be collected regularly, on a fortnightly or monthly basis, to start with. Forestry items should be included in the scope of the all India Index Number of Wholesale Prices. A careful analysis of the costs of various operation from the stage of plantation to the actual marketing of timber on the basis of economic concepts and usual principles of costing is necessary to indicate the lines on which improvement in the efficiency of forest management could be effected. Regular data on labour employed in forest activities should be collected according to uniform concepts and definitions.

14.2.36 In order to enable the collection of various types of forest statistics, a wholetime Forester (Statistics) should be provided in each range. Similar Units should be set up at the divisional and circle levels. At the State Headquarters, the Chief Conservator of Forests should be assisted by a Director of Forest Statistics. At the Centre, the existing Statistical Unit in the Central Forestry Commission should be developed into a fullfledged Statistical Division and put under the charge of a Statistician in an appropriate scale.

Input Statistics

14.2.37 In the field of input statistics, data on consumption of fertilisers by crops and by size classes of holdings are important, and should be collected through the comprehensive scheme for cost of cultivation of crops or through special surveys. Statistics of seed production and distribution and seed rates of different crops and varieties should be collected and compiled regularly. Regular information on quantities of pesticides produced, distributed and applied to different crops should also be collected systematically.

14.2.38 Three types of statistics of inputs can be distinguished. The first relates to basic data on inputs, namely, seeds, fertilisers, pesticides and agricultural machinery produced, distributed and utilised for different crops at all India, State and district levels. These are aggregative types of data, most of which can be compiled on the basis of returns furnished by the concerned manufacturing concerns and distribution agencies. Information on cropwise utilisation of inputs may have to be based on sample surveys. The second type of information relates to use of inputs, classified according to the holdings on which they are used and their characteristics, identification of areas where consumption is poor, factors which inhibit consump-

tion of fertilisers and impact of credit, weather, irrigation etc. on consumption of fertilisers. The third category of information deals with technical coefficients, dosages of fertilisers, seed rates and input application practices, responses to various inputs etc. These data will have to be based on special studies such as farm management investigations, cost of production studies, agricultural experiments etc.

Market Intelligence

14.2.39 Fairly detailed, comprehensive and reliable data on wholesale prices of agricultural commodities are available in India. At the Centre, the DES obtains telegraphically daily wholesale prices in respect of 140 markets. Weekly wholesale prices are collected from about 530 markets in respect of 130 agricultural commodities. In addition, weekly data on market arrivals and stocks are reported from 1,300 markets spread all over the country. Further improvements in market intelligence should be in the following directions :

- (i) efforts should be made to issue periodical reports on outlook for future;
- (ii) market intelligence for pulses, edible oils, important fruits and vegetables, minor oilseeds and condiments and spices should be organised on the same lines as for cereals and fibres;
- (iii) the study on costs and margins should be extended to more centres and crops;
- (iv) all the regulated markets should be made reporting centres for price collection;
- (v) whole time technical reporting agencies should be set up in all the important wholesale markets according to a phased programme; and
- (vi) the scope of market news service should be extended gradually.

14.2.40 The scope and coverage of foreign market intelligence has not received adequate attention so far. This should be reviewed in consultation with the Ministry of Commerce and adequate arrangements made for the systematic collection of these data. The availability of data on stocks with farmers, consumers and various agencies such as wholesalers, retailers etc., should be improved. The Committee on Improvement of Agricultural Statistics should look into this question and evolve an appropriate methodology for this purpose.

Agricultural Census

14.2.41 In the context of the approach to planning discussed in the previous section, the Agricultural Census through complete enumeration of holdings to give the number, size and other characteristics of holdings becomes important. The method adopted for the Agricultural Census, conducted with 1970-71 reference year as part of the 1970 World Agricultural Census, was complete enumeration by retabulation of data already available in the land records, except in the States where land records were not maintained. In these States, the method of sample survey was adopted. The Ministry of Agriculture and Irrigation proposes to repeat the Agricultural Census, but on a sample basis, with agricultural year 1976-77 as the reference period. The Commission commends the proposal. Special efforts are necessary to see that the data for 1976-77 census become available by the end of 1978 at the latest.

Integrated System of Agricultural Surveys

14.2.42 For meeting the data needs in the sphere of agriculture, the best approach is to devise an integrated system of agricultural surveys, covering both current surveys and periodical agricultural and livestock censuses. The integration essentially consists in combining, wherever feasible, surveys with the common sampling units and staggering the programme of collection of data over a period of five years taking up a major group of items each year. Sample surveys can be superimposed on complete enumeration enquiries, both for checking the reliability of the data and for providing additional information. The agencies for the collection of data can also be employed rationally by combining different surveys.

14.2.43 Four types of surveys are envisaged : (a) those with field as the unit; (b) those with holding as the unit; (c) those with livestock holding as the unit; and (d) cost of production enquiries. All these together could form National Agricultural Surveys. The items to be canvassed in the case of surveys with field as a unit by rotation over a five year period, should be improved seeds, fertilisers and manures, irrigation, drainage and soils, plant protection and cultivation practices and extension. Those with holding as a unit would be characteristics of holding, data for production and utilisation accounts, debt, investment and savings, employment, unemployment, under-employment, etc. and food consumption and nutrition. In the field of animal husbandry, the five year programme should successively cover : (a) quinquennial livestock census; (b) milk and milk products; (c) poultry and poultry products; (d) wool; and (e) meat and meat pro-

ducts and hides and skins. The cost of production surveys should also be conducted in a phased manner.

14.2.44 The different integrated surveys should continue to be carried out by the agencies responsible for the different subjects as at present. There should, however, be adequate arrangements for technical coordination and guidance. The Governing Council of the NSSO should examine this question further. As techniques of agricultural planning are improved, a continuous appraisal of the resources of agricultural holdings will be necessary, and it is possible to collect the information through the "Perpetual Inventory Method". This development may be kept in view in the future agricultural statistics system of the country.

Research Statistics

14.2.45 Among the information vitally needed for research work in agriculture, is a unified record of experimental data in the country, which has been provided by the National Index of Field Experiments. The scope of the surveys on assessment of the high yielding varieties programme initiated by the IARS should be expanded to provide information on the local factors and problems contributing to low or high yields in different regions to serve as the basis for accelerating the pace of agricultural development. The work regarding the determination of the optimum dosages of fertilisers for different crops in different regions should be expanded. The IARS should be suitably strengthened to tackle the various research problems, to coordinate and supervise the programmes of statistical surveys dealing with methodology and to expand the programmes of training in agricultural statistics.

Derived Statistics and Indicators of Agricultural Economy

14.2.46 The main derived statistics that are at present being published are the different agricultural index numbers series and growth rates. Revised series of all India index numbers of area under crops, net area sown, cropping intensity, cropping patterns, crop yields, productivity per hectare and agricultural production, with triennium ending 1961-62 as the base, are being compiled and issued by the DES. Similar index numbers should be issued for all the States, and all India and State series of index numbers should be published every year with the minimum possible time lag. The compilation of new series of index numbers of harvest prices, as recommended by the Technical Committee on Index Numbers, should be initiated as early as possible. The compilation of the revised series of index numbers of parity between prices

received and prices paid by the farmer should be taken up by all the States. Statewise and districtwise studies of growth rates in agriculture should be undertaken at more frequent intervals. Technical coefficients for input/output relationships should be worked out on the basis of the data collected under the Comprehensive Scheme on Cost of Production of Principal Crops. Time series data on crop yields should be analysed periodically to provide the basis for fixation of insurance premia for different crops/regions.

Tabulation, Publication and Dissemination

14.2.47 Most of the tabulation of regular official agricultural statistics is done at different levels manually or through simple calculating machines. In view of the enormous advantages of computers and the proposal for setting up computer centre and data bank at State and regional levels, the scope for increasing use of computers in agricultural statistics needs to be carefully examined. A beginning in this regard should be made by transferring the basic data for past years to magnetic tapes for depth studies, easy and timely retrieval and accuracy of tabulation.

14.2.48 A review of the publications in agricultural statistics shows that although a number of improvements in the contents, coverage, timeliness etc. of different publications have been effected during recent years, there is still scope and need for further improvements to serve the needs of various users. The delay in bringing out the publications can be remedied by providing the departments concerned printing facilities of their own or reserving a Government Printing Press for such statistical work. To help research workers to locate the desired information, a bibliography of all printed or cyclostyled reports on different aspects of agriculture, including those intended for limited official use, should be brought out by a Central agency regularly. Efforts should also be made to issue Situation and Outlook Reports containing upto-date and authentic information on production prospects, prices, exports etc. in respect of important agricultural commodities

Organisational Set-up

14.2.49 For proper development of agricultural statistics, a sound and comprehensive organisation is needed at different levels. At the primary level, the Patwari has to continue to collect the basic agricultural statistics relating to land utilisation, area under crops and irrigation based on complete enumeration of all fields, subject to the improvements suggested earlier. For a radical improvement in agricultural

statistics, it is necessary to have a professionally competent, fully trained and unified statistical organisation from the level just above the Patwari and/or Kanungo up to the State and Central levels. It is necessary to provide one Statistical Supervisor under the Tehsildar to supervise the field work of different censuses and surveys. To improve the accuracy of tabulation, he should be provided a hand operated calculating machine.

14.2.50 At the district level, a statistical unit consisting of a District Agricultural Statistics Officer, assisted by one Statistical Supervisor/Assistant and one Junior Clerk/Computer, should be provided to supervise and coordinate the agricultural statistics work. He should work under the Chief Agricultural Development Officer. One hand operated calculating machine should be provided to ensure accuracy in the computational work at the district level. At the State level, the existing organisation for agricultural statistics should be strengthened. The head of the State agricultural statistics organisation should be a qualified statistician with adequate experience, and should be given an appropriate scale of pay. The Agricultural Statistician should be administratively under the Agricultural Production Commissioner, and should be physically located in the same office. He should be assisted by adequate supporting staff. At the Centre, the Agricultural Intelligence Division of the DES the NSSO and the IARS should be suitably strengthened. Suitable training courses should be developed for periodic training of statistical staff employed in the State and Central Offices.

Agro-Economic Research

14.2.51 The main agencies engaged at present in agro-economic research are : (a) agro-economic research centres (AER) and farm management studies (FMS) centres financed by the Ministry of Agriculture and Irrigation; (b) Indian Council of Agricultural Research (ICAR); (c) Indian Council of Social Science Research (ICSSR); (d) agricultural and other universities; and (e) other institutions. Even so, there remain significant gaps in information and knowledge. There is need for placing agro-economic research on a sound footing and having greater coordination of the work of various agencies involved so that information of interest to Government is obtained at short notice, almost on tap. Taking into account the immediate needs of agricultural planning, the priority areas for concentration of future efforts should be as follows :

- (i) problems of small and marginal farmers and agricultural labourers, including evaluation of SFDA and MFAL programmes and assessment of their impact on the weaker

- sections of society;
- (ii) agricultural labour, employment, unemployment and wages;
 - (iii) problems of special regions, including those of drought-prone areas, hill areas and tribal areas;
 - (iv) analysis of regional disparities in agricultural growth, including probe into the backward monsoon agriculture of eastern States;
 - (v) pattern of income distribution, savings and investment in rural areas, particularly those benefited by intensive agricultural programmes;
 - (vi) economics of dryland farming, multiple cropping and improved agricultural practices like fertilisers, new seeds, pesticides, etc;
 - (vii) economics of improved water use and water management practices in irrigation projects;
 - (viii) impact of mechanisation on employment, agricultural productivity and income;
 - (ix) economics of livestock, poultry keeping, dairying and fisheries;
 - (x) economic aspects of storage and marketing of agricultural produce;
 - (xi) changes in consumption pattern and standards of living of different classes in rural areas;
 - (xii) cost benefit analysis of different development projects in the field of agriculture;
 - (xiii) integrated area development;
 - (xiv) role and impact of economic incentives for agricultural development; and
 - (xv) capital formation in agriculture.

14.2.52 The studies indicated above may be divided into two broad categories : (a) those which need collection of information from micro level units and (b) those based on secondary data. Institutions having field level staff, like the AER centres, can be entrusted with the former type of studies, while the latter may preferably be arranged at post-graduate centres of research. Further, post-graduate students of the agricultural universities should be involved in the process of economic investigation, data collection and analysis by including investigational work in the field of agricultural economics as an integral part of the curriculum. Research scholarships or fellowships should be arranged at specialised institutions for systematic analysis of the information collected during the village surveys by the AER centres so as to provide an insight into the growth and development process of Indian economy. The cadre authority administering the Indian Economic Service and

Indian Statistical Service should, in consultation with the Ministry of Agriculture and Irrigation, select eligible and competent candidates, who are desirous of developing research experience, for these fellowships.

14.2.53 With the initiation of the comprehensive scheme of cost of production, importance of the farm management studies has been played down. These farm management studies provide a lot of useful information and should be continued. In May 1975, the Coordination Committee for AER centres was reconstituted into a Coordination Committee for organisation of microeconomic studies in the field of agricultural economics. All important research institutions independently engaged in agroeconomic research should be represented on this Committee. The Research Division of the DES would need some strengthening in view of the expansion of work and the additional responsibility it is expected to undertake. The Economic Policy Cell of the DES also needs to be strengthened to enable it to provide leadership in organising microeconomic studies and preparing reports on integrated studies relevant for agricultural planning.

3 ADMINISTRATION

14.3.1 Administrative involvement in intensive cultivation at the field level was minimal till the early forties. It began to grow with the Grow More Food (GMF) Campaign, increased considerably after Independence with the Community Development Programme, and became deeper in the sixties with the intensive agricultural programmes in different sectors. Despite these developments and the accompanying expansion of the administrative base, the basic administrative structure for agricultural development was found generally inadequate to meet the demands of modern agriculture. This inadequacy was particularly noticeable from the mid-sixties when there was a sudden spurt in modernisation activity in several sectors of agriculture based on advances in scientific knowledge.

Field Level Administration

14.3.2 The field level administration in the various disciplines of agriculture being generally run from the district headquarters, a district should be taken as the basic unit of agricultural administration. The principal field officer in each of the disciplines at the district level will have, at the next lower level, a technical graduate in command. The lowest functionary in the National Extension Service is the Village Level Worker (VLW). He is a competent functionary insofar as the pro-

motion of well laid out mass programmes in crop production and animal husbandry are concerned, but requires improvement in his technical competence.

14.3.3 The VLWs should continue to be multipurpose workers but should deal with different disciplines of crop production, animal husbandry, fishery and farm forestry only. Of the ten VLWs in the block under the general pattern, eight should be allotted for agricultural work and only two may look after extension work in spheres other than agriculture. The eight VLWs will work under the Block Agricultural Development Officer (BADO) through the extension officers in the respective disciplines, whereas the other two will work under the Block Development Officer (BDO). Inservice training and refresher courses should be arranged for them to keep them upto date with latest developments in agricultural sciences and technology.

14.3.4 Scientific agriculture is highly specialised and comprises various subject matter fields even within a branch of agriculture. Competence in different agricultural disciplines is, therefore, essential for tackling the various problems which crop up at the field level. The existing field organisation alone will not be in a position to tackle all the problems. It is necessary to set up a group of technical experts at the taluk/block level for crop production. Such groups will also be necessary for other sectors like animal husbandry, fishery and forestry. The levels at which these groups are to be set up will have to be determined according to the intensity of programmes envisaged for any area. At present subject matter specialists are provided at the district level only, where intensive programmes are in operation. Generally, they are not of the required qualifications; nor specialists have been provided in all important disciplines. The district level specialists should preferably be holders of Ph.D degree, while those at the block level should be holders of M.Sc degree. The number and type of specialists required would depend upon the problems faced in a district, its agro-climatic conditions and the priority of different development programmes in the area. There is, however need to strengthen the district level team with the inclusion of an agricultural economist and a farm management specialist.

14.3.5 In most States the arrangement linking the extension staff and the panchayati raj institutions at the three levels of village, block and district, worked reasonably well as long as the programme was limited to marginal improvements in agriculture, but was found wanting when major changes were sought to be brought about through intensive programmes like the IADP, HYVP etc. A major problem was the inadequate attention to agricultural development by the elected bodies. Thus, depending upon the interest of the elected representatives in

securing rapid agricultural growth, there could be two systems to choose from. Ordinarily, there should be a direct line of control from VLW to the district officer, but the technical organisations would work in close association with the elected bodies. Where the zila parishad is active and effective, the district field organisation might be placed under its control, but even then, the linkup between the taluk/block and village level technical organisations and the corresponding panchayati raj institutions, if any, will have to be severed so that there is unified technical and administrative control at the district level.

14.3.6 At present, there is no single organisation coordinating the work of district level officers under different departments dealing with agriculture and non-official agencies like cooperatives, banks etc. Multiple offices under the same department with coterminus jurisdiction make the task of coordination at the field level rather onerous. The task of coordination has become more complex with the emergence of a number of independent institutions dealing with credit, inputs and services required by farmers. Besides, there is the larger issue of co-ordination between departments dealing with crop production, animal husbandry, fisheries and forestry at the district level.

14.3.7 In the existing setup, coordination of agricultural development programmes is sought to be affected in most States through the District Collector. The basic limitations with the Collector as a co-ordinator of agricultural development programmes arise from his pre-occupation with other multifarious duties, the short tenure of his office and generally his inability to keep a continuous check on the progress of numerous schemes and attend to the administrative bottlenecks in their implementation. The initiative in organising agricultural activities lies mainly with the district level technical officers under him; but they do not enjoy the necessary freedom of action. Experience, however, shows that team work among closely related technical departments can be secured through one officer, who has the requisite understanding of the problems of these departments and their interrelationship. Coordination in agricultural sector at the district level should be achieved through a senior technical officer, to be designated as Chief Agricultural Development Officer (CADO). The District Collector should not have administrative control over district officers in various agricultural disciplines nor should he be concerned with their detailed working.

14.3.8 The CADO should be a sufficiently senior officer belonging to any one of the disciplines of agriculture, animal husbandry, fisheries, forestry, cooperation, etc. to function as the principal coordinator of all agricultural activities at the district level and provide the essential link not only between officers in the field of agriculture but also in relation to other departments, institutions and autonomous bodies in the field.

of agricultural development. He should not interfere with the working of technical officers, except when required for purposes of planning, coordination and progress evaluation. District level officers under different departments will continue to function independently, as at present, under their respective departmental heads at the regional/State headquarters, thus ensuring a direct line of control. The ability and quality of leadership of the CADO being important for much of the success of agricultural development programmes in the district, he must be a carefully selected and trained officer. Subject to eligibility and competence, officers of the different agricultural departments should be given their due share in the pool of officers from which the selection of CADO is to be made. Once appointed, he should be in position for at least five years so that he is able to comprehend local problems fully and tackle them effectively.

14.3.9 There should be a separate planning and coordination unit at the district level under the CADO, which should also deal with progress and evaluation. This unit will be the main tool for formulating action programmes and plans for agricultural development of the district and achieving coordination among various agencies connected with agricultural development. The unit should be equipped with trained staff including an agricultural economist and a statistician.

14.3.10 The planning unit should have operational links with non-official agencies and autonomous bodies operating in the field of agriculture. There is, therefore, need for constituting an agricultural coordination council at the district level under the chairmanship of CADO, on which these agencies can be represented. District officers in agriculture departments and subject matter specialists will also be members of the council. It will be an advisory body, and the follow up action on its decisions will be the responsibility of the CADO and the planning unit under him.

14.3.11 For the same reasons, as in the case of the District Collector, the BDO too will not be in a position to provide effective leadership in the execution of agricultural programmes at the block level. There should be a Block Agricultural Development Officer (BADO) at the block level, who would be directly responsible to the CADO and who would play the role of the coordinator at the block level. The BDO should deal with only programmes of non-agricultural sectors.

14.3.12 The selection, appointment and administrative functions of the BADO will be determined broadly on the same principles and considerations as in the case of CADO. As at the district level, there should be a unit under BADO to watch the progress of agricultural development programmes. This unit will maintain all data relating to

progress in different fields, as also data relevant to agricultural planning. It will also maintain close contact with farmers' service societies. Besides, there should be block agricultural coordination committee for coordinating the various agricultural programmes.

14.3.13 In the organisational scheme envisaged, the continuance of the VLW as an essential link between the expert and the farmer, is necessary, and he should work as a last link in the chain of agricultural development devoting cent per cent of his time for agriculture. The strength of the extension staff, VLW and AEO, will have to be augmented suitably to ensure a more effective extension service to farmers, though the norms regarding staffing pattern will vary from area to area and need to be worked out separately for each area. It will also be necessary to have trained Gramsevikas for organising women's programmes. However, to be effective, the extension staff will need the support of an organisation in close proximity to the farming community for assuming the complementary package of services and supplies. This support will be provided by farmers' service societies, which will function as a complement to the extension setup under the AEOs.

State Level Organisation

14.3.14 At the State level, matters relating to agricultural development are attended to in several secretariat departments, like agriculture, animal husbandry, fisheries, forestry, cooperation and rural development. The number and grouping of subjects handled by each varying considerably from State to State. Besides, there are several directorates for handling technical matters, each under the charge of a Director, who is also the Head of the Department.

14.3.15 An integrated Department of Agriculture and Rural Development at the secretariat level under a senior officer, as recommended by the Ram Subhag Singh Committee for effective coordination and comprising agricultural and allied departments, will be unsuitable due to its unwieldy workload for efficient management and the varying needs of the type and degree of coordination in each field and between fields of crop production, animal husbandry, forestry and fisheries. Integration of all these subjects into one secretariat department may not be necessary provided adequate arrangements for coordination can be made. There should be separate departments at the State level, at least for agriculture, animal husbandry, fisheries and forestry in all major States, depending upon the importance of the different subjects in a State and the work load under each subject. At the same time, there is need for having a single officer of the status of Agricultural Production Commissioner-cum-Principal Secretary to the Government to plan,

direct, guide and coordinate the activities of various departments. The post of Agricultural Production Commissioner (APC) has been created in a number of States. Those States, where APCs have not been appointed, should take immediate steps for appointing one. The APC should be in rank only next to the Chief Secretary of the State. All important policy matters relating to agriculture should pass through him to the Cabinet Minister-in-charge of agriculture, and he should be empowered to make decisions on all major policy issues.

14.3.16 At the Ministerial level, the best arrangement to ensure coordination would be to entrust the task to a senior Cabinet Minister with overall responsibility for all subjects in the sphere of agricultural development. He should be of the status of Deputy Chief Minister as the work of agricultural development would have a bearing on the activities of other departments like industry and of different Ministries. For handling different subjects, there could be Ministers of State; the number and grouping of subjects to be handled by them would depend on the work load and their interrelationship. Thus, by having APC as a super coordinating officer in respect of all agricultural development matters at the secretariat level and having Cabinet Minister in charge of agriculture in the rank of Deputy Chief Minister, it would help to secure the objective of rapid agricultural development in the country.

14.3.17 Separate directorates for agriculture, animal husbandry and fisheries are necessary at the State level. Where there are several directorates functioning within the field of agriculture or animal husbandry or fisheries, the senior most Director should be designated as the Director-in-Chief and be entrusted with the responsibility at the State headquarters for coordination.

14.3.18 Unlike the Directorate of Agriculture, which directly handles extension and vocational training, such extension of training programmes are not being organised for other disciplines like animal husbandry, fisheries and forestry. It is, therefore, necessary to have a technical directorate for extension and training at the State headquarters under APC. This organisation may also deal with women's programmes and act as the secretariat for the proposed joint specialists' councils at the State level.

14.3.19 In the existing system of a common planning organisation at the State level, Agricultural Departments are not fully involved in the planning process and the problems associated with implementation of programmes are not properly recognised. There should be a separate unit for planning, coordination and evaluation, exclusively for agriculture, under the APC. It would enable a two-way traffic in planning, policy formulation and decision making between the planning unit at the State level and counterpart organisations at district and block levels.

The unit will be the main instrument with the APC for coordinating the activities of the different secretariat departments, technical directorates and other organisations. Preparation of technical programmes will continue to be the responsibility of each technical directorate or concerned implementing agency, and the planning unit under the APC will ensure that the programmes worked out by these agencies are tied up within the framework of a unified plan and budget. The planning unit will work in harmony with the budget and finance unit.

14.3.20 Similar planning cells will have to be organised under different integrated directorates. The planning cells will function in close contact with budgetary cells in the directorates.

14.3.21 There should be a budget control unit under the APC to have overall supervision over utilisation of the budget provisions, and for taking steps to divert funds in time from one head to another within the overall budget for agriculture. Also, each department/directorate should have its own budget cell which would be responsible for the detailed budget control.

14.3.22 In order that the subject matter specialists under the Departments of Agriculture, Animal husbandry, Fisheries etc. at the State as well as the district level are of high calibre, they have to be in touch with the mainstream of research. It is, therefore, desirable to form joint specialists' councils at the State level under the respective departments comprising the subject matter specialists under the departments and top level subject matter experts in the various faculties of the agricultural university in the State. The council may make periodical assessment of the state of science in the light of field requirements, and advise on technical matters having policy implications. In order to maintain the technical competence in State departments, provision should also be made for exchange of staff at appropriate levels between the universities and the departments on deputation basis. Keeping in view the division of responsibility between the agricultural university and the departments in the matter of research, steps need be taken to strengthen the structure for adaptive research in the departments. It is desirable to set up adaptive research cells at the level of technical directorates which can function in close liaison with the agricultural universities.

14.3.23 The supply functions which the departments in some States undertake affecting their extension functions, should appropriately be entrusted to institutional agencies and other alternative systems outside the departments. The departments will, however, be responsible for the proper coordination of the supply and related agencies so that various farm inputs are made available in a synchronised manner. The main concern of the department will be development, extension and regula-

tory functions. For regulatory functions, a separate wing with supporting staff at different levels within the organisational framework will be necessary. The extension staff of the department attending to agricultural development and promotional work should not attend to the regulatory work.

14.3.24 The strength and pattern of staffing in departments and directorate are generally linked with plan schemes, and are not determined by any systematic plan for strengthening the administrative structure, keeping in view the needs of agricultural development of the State as a whole. The cadres of the departments concerned with agricultural development should be built on a stable basis, taking into account a total and long term view of the additional requirements of developmental staff.

14.3.25 The divisional level of administration is justified only in case of large States with a very large number of districts and regional homogeneity. Such cases, however, should be exceptional, and even where divisional level is introduced, its function should be limited to regional planning and coordination.

14.3.26 The relationship between technical heads of directorates and secretariat departments also needs to be restructured. Viewed from the wider perspective of providing to the technical personnel the required status and incentives and involving them in the decision making process at the secretariat level, top management posts in the secretariat, including those of Secretaries and Joint Secretaries, should be held by technical officers of the various directorates and executive departments. The post of APC should be filled from among the Secretaries of the Departments; he should, preferably, be a technical officer. Similarly, technical officers should be provided maximum opportunity for manning other senior positions of management in agricultural development corporations, agencies, boards etc. Induction of technical officers into senior posts at the secretariat level will itself lead to much better communication and understanding between the heads of technical directorates and the secretariat. To facilitate quicker decisions, the heads of technical directorates can be granted suitable ex-officio secretariat status, to authorise them to issue sanctions on behalf of the Government and render technical advice to Ministers direct, when required, without burdening them with secretariat duties. The technical directorate being the main source of technical control and guidance in the connected fields, these directorates should be specifically declared as technical organisations, and a provision to the effect that these positions should be held by technical officers alone should be incorporated in the recruitment rules. There is no justification for placing generalists or administrators as heads of technical

directorates.

14.3.27 The technical cadres in Agriculture Departments in many States are treated with discrimination, and their grades of pay and status in the bureaucratic structure remain the lowest. Even between technical departments in different States, there are wide differences in scales of pay etc., which come in the way of officials from some States getting posts at the Centre. It is desirable that all States follow uniform pay scales and prospects for the agriculture cadre, which should be comparable to those in the administrative service. All Central technical posts should generally be filled by deputation from the States. The period of tenure should not be too short, and may be fixed at 5 years. In the selection of these officers, their position in the cadre and their competence rather than their pay-scales should be the criteria.

14.3.28 A strong agricultural administration can be developed in the country if an All India Agricultural Service is formed, in which technical officers at the Centre as well as in the States at the level of class I and above are encadred. This service should have different wings for agriculture, animal husbandry and fisheries. There is already an Indian Forest Service and an Agricultural Research Service. Pay scales of the administrative and technical services should be at par so that the choice of a candidate of his career is guided more by his inclination and aptitude rather than by allurement of pay scales and prestige of different services. There should, in addition, be State Agricultural Services, junior and senior, with provision for inducting competent persons from the senior State services to the all India Service on quota basis.

14.3.29 For ensuring coordination at the highest level, there may be an Agricultural and Rural Development Council which may be set up as an advisory body at the State level under the Chairmanship of the Chief Minister or Deputy Chief Minister. The Council will consider the basic approach and policy issues and review general progress of plans.

Central Agricultural Setup

14.3.30 The Central Ministry of Agriculture and Irrigation, as constituted in 1974, consists of the Departments of Agriculture, Agricultural Research and Education, Rural Development, Food and Irrigation. The Department of Rural Development came into being replacing the Departments of Community Development and Cooperation. The functions of the erstwhile Department of Cooperation were bifurcated between the Departments of Rural Development in the

Ministry of Agriculture and Irrigation and the Department of Civil Supplies and Cooperation in the Ministry of Industry and Civil Supplies. Cooperative agricultural credit went to the former and other functions including consumer cooperatives, cooperative policy, training and law, and the National Cooperative Development Corporation (NCDC) to the latter.

14.3.31 Some readjustment in the allocation of subjects among the various departments would be required to ensure functional integration and smooth functioning. The separation of cooperative agricultural marketing and the NCDC from the Ministry of Agriculture and Irrigation is not in keeping with the objective of functional integration. A service division like credit and marketing should be better placed under the Department of Agriculture. Minor irrigation and Central Groundwater Board (CGWB), which are at present under the Department of Agriculture, should be transferred to the Department of Irrigation in the interest of integrated development of surface and groundwater resources. In the field of fisheries, some development programmes are under the charge of the Marine Products Exports Development Authority and some with the Department of Agriculture giving rise to possibility of duplication of effort. All development activities relating to fisheries should be the concern of the Department of Agriculture. The statutory boards for tea, coffee, rubber and cardamom under the control of the Ministry of Commerce have separate research and extension organisations. These should be transferred to the ICAR and to the extension setup in the Ministry of Agriculture and Irrigation, respectively. The Ministry of Commerce may, however, continue to handle the marketing aspects of these commodities, including their export.

14.3.32 The implementation of the comprehensive recommendations made by the Commission for agricultural development would entail an enormous increase in the workload of the Central Ministry of Agriculture and Irrigation. The nature and magnitude of the problems to be handled would warrant the creation of some new departments to facilitate smooth working. The different departments under the Ministry at the Centre should be those of agriculture, crop production, animal husbandry, fisheries, forestry, irrigation, rural development, research and education and food. With the creation of a few new departments, and a rational distribution of subjects among the different departments, some changes will have to be made in the present arrangements. To ensure effective coordination of different activities of the various departments, there should be a Principal Secretary in the Ministry, who would assume the role of a coordinator. He would also be in charge of the Department of Agriculture, which will

deal with the most important functions of planning, budget and finance, area development programmes, extension, agricultural credit, economics and statistics, foreign aid, etc. The post of Principal Secretary should be filled by the best man available for the job, irrespective of whether he is a generalist administrator or a technical expert. The Secretaries of the Departments of Crop Production Animal Husbandry, Fisheries, Forestry, Irrigation and Research and Education should be scientists, specialised in respective fields. This is keeping with the changes already made by the Government in other technical departments and Ministries where scientists and technocrats have been placed as Secretaries. For coordination between research and development at the Central level, there should be a Joint Council consisting of Secretaries of development departments and of the Department of Agricultural Research and Education, with the Extension Commissioner as Convenor and presided over by the Principal Secretary of Agriculture. It will also function as an agency for consultation, evaluation and coordination between the production divisions and extension organisation.

14.3.33 The chain of planning units at both field level and State level, should be completed by having a well-organised Planning Division in the Ministry of Agriculture and Irrigation dealing with formulation, coordination and evaluation of the plans as well as overall agricultural policy. The Planning Division, as also the Budget and Finance Division, which will work in close harmony, should be placed under the Principal Secretary to enable him to act as an effective leader of the team. The Division may be headed by a senior officer of the rank of Additional Secretary having the required qualifications and background.

14.3.34 In the distribution of work in the Central administration, functions which are important for agricultural development are located amongst several Ministries and Departments. Unless a policy acceptable to all the concerned Ministries and Departments, can be laid down, and a coordinated action programme is accepted by all the implementing agencies, the Central Ministry of Agriculture and Irrigation cannot perform the role of a planner and coordinator of agricultural development programmes of the country. A machinery has, therefore, to be developed to ensure a quick response to policy by all concerned as also good performance. At present, at the secretariat level, such coordination in specified fields is achieved through high powered interdepartmental committees. Similar high level committees may be constituted, wherever the need arises for policy coordination amongst Ministries and departments. It is also necessary to form similar *ad hoc* groups of implementation under

different departments of the Ministry of Agriculture and Irrigation in order to expedite executive action.

14.3.35 An attempt should be made in the Ministry to unify action in certain fields like agrarian legislation, regulatory Acts, etc., as far as possible, keeping in view that agriculture is extremely regional in character and an all India frame in details may not work. The Division for land reforms and land management legislation under the Department of Agriculture should be entrusted with the study of agrarian legislation and regulatory Acts with a view to identifying deficiencies of the existing legislation and creating consensus for model legislation.

14.3.36 The Directorate of Extension has given good leadership in training, but in extension, bulk of the work is confined to crop production. With the introduction of various programmes of development of animal husbandry and fisheries, there is a need for giving extension support for these programmes. Hence, the extension setup will have to be suitably organised and equipped to put across the ideas which are prepared by the production divisions of the Ministry. Since this organisation has to deal with all aspects of agricultural development it should be placed under the Department of Agriculture, under the Principal Secretary. The Extension Commissioner should be a technical officer of the rank of Additional Secretary. The Directorate, which will be a source of guidance and advice regarding extension organisation, training and communication at the Centre, should be strengthened. The Joint Council under the chairmanship of the Principal Secretary, referred to earlier, would provide the machinery for mutual consultation and coordination between the production divisions and the extension organisation.

14.3.37 The efforts of the Departments of Rural Development, Social Welfare and Health, Directorate of Extension and Central Social Welfare Board which are at present dealing with development programmes concerning women and children, do not seem to have made any impact. It is desirable that the different programmes in the field are coordinated by the Home Science and Nutrition Education Section of the Extension Directorate, and are brought under its fold. To begin with, this Section should be converted into a fullfledged Directorate of Womens' Programme and placed under the administrative control of the Extension Commissioner. This Directorate would be responsible for the formulation and execution of a comprehensive programme exclusively for rural women and children. It should maintain direct liaison with State Governments in matters concerning training of personnel and programme guidance, and act as a consulting body to other departments and Ministries and home science colleges and universities in connection with the development of curricula,

personnel training etc. There should be ultimately a fullfledged division in the Department of Agriculture to look after women's programme.

14.3.38 In order that the Centre is able to provide effective guidance to States, the technical divisions in the Ministry of Agriculture and Irrigation should possess the right kind of expertise. Decentralisation of powers to the directorates and executive organisations should be carried out fully so that the experts in the Central departments are able to devote their entire time to professional and overall direction to the national programmes in the States and at the Centre.

14.3.39 The aforesaid organisational steps will have to be supplemented by constituting a Consultative Council at the Central level for facilitating decision on key issues having overall importance. The heads of departments or divisions or the Secretaries-in-charge of Agricultural Departments and representatives of State Governments should be associated with the Council. The Council should be presided over by the Minister of Agriculture and Irrigation. It will be concerned primarily with basic policy issues and approaches and will be supported, in actual operation, by the Planning Division at the Central level. Besides, there may be separate consultative groups for agriculture, animal husbandry, fisheries, forestry etc. for mutual consultations, which can be formed at the Secretary's level and may include heads of divisions, heads of departments at the State level and other experts. Important policy issues, which cannot be resolved at Secretary's level may be placed before the Conference of State Agriculture Ministers. In this way, a link can be established between the Consultative Council and the Conference of State Agriculture Ministers.

14.3.40 In most of the technical divisions, there is a technical hierarchy along with administrative hierarchy. Since establishment and personnel matters have been separated and are dealt with in a centralised manner by the Establishment and Personnel Administration Division, there is hardly any need for two separate hierarchies. The system of multiple technical-cum-administrative hierarchies, in which papers have to pass through several stages before a final decision is taken must be changed, and an officer oriented system introduced, in which responsibilities are clearly fixed at each level. Disposal of any case should not generally involve more than two levels.

14.3.41 The duality between a technical head, such as Agricultural Commissioner or Animal Husbandry Commissioner, and an administrative head, who is in overall charge of the division such as an Additional Secretary or Joint Secretary, should also be removed. The Agricultural Commissioner, the Animal Husbandry Commissioner, the Fisheries Commissioner and the Inspector General of Forests should be Secretaries of the concerned departments. The Agricultural Market-

ing Adviser and the Plant Protection Adviser should be given ex-officio status of a Joint Secretary. The Extension Commissioner should be given the ex-officio status of an Additional Secretary, and the Economic and Statistical Adviser that of Joint Secretary. The entire Ministry of Agriculture and Irrigation should mostly consist of technocrats with necessary administrative and management training.

14.3.42 The posts of Commissioners of Agriculture, Animal Husbandry and Fisheries and Inspector General of Forests should be filled, on a tenure basis, from amongst competent and senior officers in the States and at the Centre. Ultimately, when the All India Agricultural Service is formed, senior officers from the service will be eligible for appointment to these posts. Further, in the case of Animal Husbandry Commissioner, the post should not be a close preserve of any one field; the recruitment should be made from amongst the outstanding scientists in the disciplines of veterinary science, livestock production or dairying.

14.3.43 There should be closer working relationship between the field units under the Central Government and those under the State organisations. As a general policy, the continuance of pilot projects, model farms etc. under the central organisations should be reviewed from time to time and those which could be transferred to the State sector should be done so immediately.

14.3.44 Development Corporations have emerged as the accepted pattern of development in almost every field. Central corporations should, however, be constituted after due consideration and only in the case of commercial/promotional ventures in order to allow greater operational freedom. The development corporations at the Central level should not be isolated from the general development and extension setup at the State level, and the attempt should not be to duplicate the State staff and organisation. However, the Ministry of Agriculture and Irrigation should not be directly involved in any operation of commercial nature.

14.3.45 The working of the general administrative setup should be reviewed periodically to keep the system under constant watch, and make it equal to the new tasks and responsibilities.

Training in Agricultural Administration and Management

14.3.46 In the new administrative system envisaged, the technical officers have been assigned important responsibilities as administrators of agricultural development programmes at all levels. To enable them to discharge these responsibilities, they have to be suitably trained in agricultural administration and management. Job oriented train-

ing in agricultural administration and management should be given at the point of entry into service, both for recruits to the proposed Indian Agricultural Service as also to the incumbents of other posts in the Central and State agricultural departments. Inservice training must be provided within a certain period of service, say 5 to 7 years, after an officer has joined service. Fresh recruits to the Indian Agricultural Service should be given training in the same way as the recruits to the IAS and other all India services. This can be given at a Central agricultural administrative college, which may be called the All India Institute of Agricultural Administration and Management. Similarly, new entrants to State Agricultural Services should be given training at staff colleges at the State level.

4 FARMERS' ORGANISATION

14.4.1 Agricultural development is closely linked with the extent of adoption of scientific practices in farming, and the latter with the urge and enthusiasm that can be created for these practices among the farming community. From the very inception of the five year plans, efforts were made by the Government to involve farmers in the development process through special institutions, but with only limited success. There is no doubt that a genuine organisation of farmers will be in a much better position to canalise the community's efforts and ensure farmers' participation in the development plans. It will also enable them to secure from the Government the necessary help and assistance.

Existing Farmers' Organisations

14.4.2 Farmers' organisations, at present functioning in the country, can be divided into three broad categories according to their sponsorship, viz., organisations set up by the Government, voluntary organisation with Government support and other voluntary organisations. The Community Development Programme had the object of securing people's participation in area development plans and inculcating in them a spirit of self help. The Panchayati Raj institutions were intended to make this involvement deeper. While these institutions sought people's participation in implementing development programmes, they did not associate them with policy making and plan formulation aspects of the programmes.

14.4.3 A number of voluntary organisations of farmers are also functioning in the country. Their aims and objectives are mainly to protect and advance the interests of farmers, organise training and edu-

cation for them and assist the authority in formulating and promoting national and international agricultural policies. Important among the voluntary organisations working at the all India level are Bharat Krishak Samaj, Kisan Sabhas, National Tonnage Club of Farmers, Bharatiya Grammen Mahila Sangh, Farmers' Federation of India and Young Farmers' Association. Generally, financial assistance is provided by the Government to the recognised organisations for specified activities. These organisations have been functioning almost independent of one another, with little or no coordination in their activities, and none has acquired the stature and strength to speak authoritatively for the entire farming community. They could create only a limited awareness about the need for modernisation of agriculture among farmers.

14.4.4 There are many other independent organisations functioning in different areas and in various States. Some of them are organisations of producers of specified field crops or plantation crops, or livestock and livestock products, and some are meant for supply of agricultural inputs. There are also single purpose organisations such as those for safeguarding the interests of agricultural labourers and tenants.

14.4.5 Despite the fact that there are a number of organisations taking care of various interests, a good proportion of the rural community remains unrepresented and uncared for. This comprises mostly the weaker sections like fishermen, tribals, village artisans and similar groups. Neither are there any organisations which have got the clear-cut objective of safeguarding the interests of small and marginal farmers and landless labourers. Most of the organisations are financially weak, which inhibits their ability for championing the cause of their members. What is, therefore, needed is a strong, professionally competent and ideologically committed organisation from the grass root level, which could motivate all sections of farmers towards planned economic growth, organise action at individual as well as group levels, and provide necessary supplies and services.

Farmers' Organisation—A Suggested Pattern for India

14.4.6 A farmers' own organisation should operate in two separate but complementary fields, one dealing with economic and service functions, and the other with promotional and welfare activites. In its Interim Report on credit services, the Commission had recommended the formation of farmers' service societies (FSS) at the block level, with branches at the circle level, for the purpose of making available to the farmer all necessary inputs, custom services, technical advice and guidance, supporting services and credit. The FSS will

constitute the economic wing of the farmers' organisation. The other wing for promotional activities may be called Farmers' Union (FU) or Krishak Sabha.

14.4.7 At the primary level, the FU will cover the same area as FSS, that is, a block or a circle with a population of ten to twelve thousand to begin with. It will be a non-political and nonsectarian body, devoted wholly to the cause of farmers and other sections of the village community. The membership of the FU will be open to all farmers, artisans and agricultural labourers, who are enrolled as members of the FSS. However, employees of organisations like zila parishad, panchayat samiti etc. may not be allowed to join the union.

14.4.8 The main functions of the FU will be to motivate all members towards planned economic development, disseminate information on modern farming and other production practices, organise training in improved methods and techniques of production and help achieve the objectives of the various development programmes. It will also undertake welfare activities such as organising adult literacy centres, youth clubs, consumer stores etc. Its finances will consist of a graded membership fee collected annually from all members, a contribution made by its counterpart FSS, and, if necessary, a levy on the produce marketed through the societies.

14.4.9 The Executive Committee of the FU will consist of up to eleven members. Seven of them will be the same as the elected members of the FSS, i.e. five representing the small and marginal farmers and two others. Four will be coopted members, one each representing landless agricultural labourers, artisans, women and scheduled castes and tribes, provided none from among these groups is represented among the elected members. When a minimum of 15 FUs have been formed in a district, they will federate into a District Farmers' Union (DFU) or Zila Krishak Sabha. The DFU will consist of Presidents or elected representatives of all FUs and coopted members to represent the weaker sections. Its main function will be to establish a regular channel of communication between the village community as represented by it and the district planning authority, assist the latter in programme planning, organise training courses for farmers and other interest groups and implement various development programmes through its constituent units. Its finances will consist of an annual contribution from the FSSs of the district, a levy on agricultural produce marketed through FSS, grants from regulated market committees in the district and a matching grant from the Government. Through the scheme of cooption, it is ensured that the interests of the weaker sections of the village community are properly represented on the farmers' organisation, both at FU and DFU level.

14.4.10 When a sufficient number of DFUs are formed in a State, they can form a State Farmers' Union (SFU) whose main function will be to apprise the State Government of the needs, opinions and expectations of the farming community in respect of development of agriculture, general rural development and welfare measures and to assist the Government in formulating a proper policy for rural development with special emphasis on agriculture. The farmers' organisation at the all India level should take the form of a National Farmers' Union (NFU). The Presidents or duly elected representatives of SFUs will constitute the NFU. Since the National and State Farmers' Unions will function mainly in an advisory and consultative capacity, it will be expedient if they are represented on other organisations, engaged in promoting the development of agricultural and allied sectors such as the Food Corporation of India, the National Seeds Corporation and the Central Warehousing Corporation at the national level, and the State agro-industries corporation, State electricity board, State land mortgage/development bank etc. at the State level. The main job of the representatives of farmers' organisation in the aforesaid bodies will be to apprise their managements of the needs and expectations of the people in rural areas and the possibilities that exist in the development of agriculture and related sectors and help evolve proper policies for framing and scheduling their programmes.

5 INTERNATIONAL COOPERATION

14.5.1 International cooperation for development over the last twenty years has been of a nature and magnitude new to history. The International Strategy for Development in the Second United Nations Development Decade and the adoption by the UN General Assembly in May, 1974 of the Resolution on New International Economic Order have added new dimensions to these efforts. India has been a major beneficiary of international cooperation for development. The inflow of assistance to India has been steadily on the increase during the first decade of planning touching the highest watermark towards the close of the Third Plan. Thereafter, there has been a significant shift in aid seeking policy towards greater self-reliance.

Review

14.5.2 Foreign aid for agricultural development is received under various multilateral and bilateral programmes as also from voluntary agencies. It generally consists of financial, technical and commodity

assistance. The major multilateral aid programmes, in which India has participated and benefited from are those which are organised under the auspices of the Food and Agriculture Organisation (FAO), the World Food Programme (WFP), the United Nations Development Programme (UNDP), the United Nations International Children's Emergency Fund (UNICEF) and the World Bank. While the FAO and the UNDP have extended mainly technical assistance by way of provision of training facilities, technical experts etc., covering almost all fields of agriculture, assistance under the WFP and the UNICEF, by and large, is confined to dairy development, livestock and poultry. The International Development Association of the World Bank, which has stepped up assistance to agriculture in recent years, has been a major source of financial aid. The projects supported by the World Bank group covered surface and ground-water development, water management, land development, promotion of farm implements and machinery, seed development, dairy development and special area programmes. Besides, regional organisations like the United Nations Economic and Social Commission for Asia and the Pacific and the Asian Development Bank have also been facilitating mutual cooperation among the countries of the region for economic development.

14.5.3 There has been considerable bilateral assistance to agricultural development in India from a large number of countries like Australia, Canada, Denmark, Finland, Federal Republic of Germany, France, German Democratic Republic, Hungary, Japan, Netherlands, New Zealand, Norway, Switzerland, UK, USA and USSR. The extent and the field of assistance vary from country to country. Technical assistance in the form of exchange of experts, joint research ventures, training facilities for nationals and supply of ancillary equipment is a common feature of most of the bilateral aid programmes. Assistance is also received in the form of loans and grants to specific programmes and supply of agricultural inputs and foodgrains. While assistance received from countries like USA and Canada covers a wide-area, assistance extended by Australia, New Zealand, Denmark, Switzerland, Netherlands and Hungary is largely in the field of animal husbandry including dairy development and processing of animal products and that by Norway, Sweden and Finland is confined to fishery and forestry. Federal Republic of Germany has made significant contribution to area development programmes, Japan to agricultural extension and USSR to mechanised farms and seed industry. India has also been receiving sizeable assistance from non-official sources such as the People's Action for Development (India), Ford Foundation, Rockefeller Foundation etc. While Ford Foundation assisted mainly through the extension programme of IADP, as also some *ad-hoc* projects, the

Rockefeller Foundation assistance has been mainly confined to strengthening of research facilities.

14.5.4 India has rendered financial and technical assistance to several developing countries of Asia and Africa in the field of agriculture mainly under two programmes *viz*; the Indian Technical and Economic Cooperation Programme (ITEC) and the Colombo Plan. Deputation of Indian experts to these countries and extending training facilities to their nationals in India constitute the main components of the programme. In addition, technical experts and fellowships in various disciplines have been provided to the developing African countries under the Special Commonwealth African Assistance Plan. Special assistance is given to Nepal, Bhutan and Sri Lanka for some development projects under the Colombo Plan, which has been steadily increasing in recent years.

Scope and Prospects of Further Assistance

14.5.5 The question of future foreign assistance in the field of agriculture is closely linked with the objective of achieving self-reliance as outlined in the Third and subsequent Plans. In the next phase of India's development, the prospects of foreign assistance in agriculture have to be explored mainly in the fields of advanced production technology, import of essential raw materials and capital goods, not available in the country, infrastructure facilities, research and training. In view of the availability of very large range of plant material to the modern plant breeder, it is necessary for the Indian breeder to keep himself abreast of the latest developments. For this purpose, international cooperation in plant breeding and seed exchange programmes will be required. Foreign assistance may also be necessary for the purchase of sophisticated laboratory, seed testing and cleaning, storage and disinfection equipment, which are not available locally. Greater use of latest developments in remote sensing and infrared photography will be useful for detecting plant diseases and assessing soil characteristics. This will need import of sophisticated equipment and foreign expertise for guiding and training Indian personnel.

14.5.6 Some import of fertilisers and pesticides (technical grades), not manufactured in India, as also raw materials and plant and machinery for their manufacture will be required till the country achieves self-reliance. Foreign assistance will also be needed for research on forecasting and control of pests and plant diseases and the most effective and/or economical use of chemicals and formulations for the purpose. It will be useful to have further foreign collaboration to build up animal husbandry on scientific lines, particularly in setting up plants

to manufacture foot-and-mouth disease vaccine, and supplying high-yielding milch animals, fine wool and mutton breeds of sheep, high quality breeding stock of pigs and poultry and equipment for frozen semen stations.

14.5.7 In the field of fisheries there is still need for development of purseining and other methods of pelagic fishing. Technological advice and assistance are also required for mid water trawling and tuna fishing. For the pulp and paper industry, part of the future long fibre needs will have to be met from the existing coniferous forests and by raising tropical pine plantations. India's experience in this regard being limited, bilateral and/or multilateral assistance for the supply of seeds and trial of tropical pine species will be required. Assistance from countries having greater experience of management of eucalyptus, a relatively new source of raw material, would have to be secured. On the industrial side, improved technology has to be developed if necessary with multilateral or bilateral assistance. Development of wild life is another area where advantage can be taken of the expertise available with international agencies.

14.5.8 India has made good use of foreign assistance in developing her own research and expertise with the result that the scope for traditional forms of such assistance especially foreign experts in basic fields has considerably diminished. Foreign experts will, however, be needed more as consultants than as regular wholetime advisers. It will also be useful to continue the scheme of fellowships for training India's scientists abroad, where new techniques have been developed.

14.5.9 In the spirit of International cooperation, economic and technical assistance would be made available by India to other developing countries under the various programmes and India could contribute significantly to agricultural research and development. In the field of crop production, it should be a part of India's policy to be in a position to provide seed to other countries. India can also provide expertise and training facilities in respect of fertilisers and pesticides. In the field of irrigation, India is in a position to assist in conducting feasibility studies and preparation of project reports, provide consultants, depute irrigation engineers and offer fellowships for training in India. India can also undertake turnkey jobs for constructing irrigation projects. In respect of Animal Husbandry, India can render assistance in setting up biological production centres for manufacture of vaccines and diagnostic agents, disease investigation laboratories and animal science teaching and research institutions, installing dairy plants and feed mixing plants on turnkey basis and setting up livestock farms. As the largest fishing nation in the Indian Ocean region, India can undertake cooperative research and investigation with the neighbouring countries

in subjects of common interest. Research institutions in marine fisheries and oceanography should be fully equipped to handle this task. In forestry, India can continue to provide facilities for education and training to students from other countries. In addition, India can offer assistance in the form of experts for field posts and teaching in tropical forestry.

14.5.10 In agricultural research there is need for world wide collaboration through arrangements with international organisations, institutions and bilateral agencies, whereby foreign scientists could work in Indian research institutions and Indian scientists in research institutes abroad. Close relations should, in particular, be forged with International Research Institutes for wheat and maize in Mexico, rice in Philippines, potato in Peru and tropical agriculture in Columbia and Nigeria. In addition, reciprocal arrangements between Indian agricultural universities and research institutes and similar institutions in other countries should be established.

14.5.11 The main tasks of the World Food Council, established recently as an organisation of the United Nations, are to assist the developing countries in increasing their food production through larger investment, assured supply of inputs, expanded research support and improved policies and services and to ensure food supplies to seriously affected countries. It is also proposed to set up an International Agricultural Development Fund in this context to assist the developing countries to increase their food production. India should take advantage of the assistance available from these sources.

(Paragraph 14.2.6)

APPENDIX 14.1

Estimates of Production of Foodgrains based on Consumption, Central and State Estimates

PLANNING STATISTICS AND ADMINISTRATION

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Year	Estimated consumption	Net imports	Changes in government stocks	Estimated net production*	Gross Production			(million tonnes)
					Estimated gross production@	Central Govt. estimates	State Govt. estimates	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
1966-67	•	•	•	76.95	8.66	(→) 0.26	68.03	77.75
1967-68	•	•	•	82.98	5.67	(+) 2.03	79.34	90.67
1968-69	•	•	•	86.59	3.82	(+) 0.46	83.23	95.12
1969-70	•	•	•	90.72	3.55	(+) 1.12	88.29	100.90
1970-71	•	•	•	94.97	2.01	(+) 2.57	95.53	109.18
1971-72	•	•	•	94.84	(→) 0.50	(→) 4.69	90.65	103.60
1972-73	•	•	•	95.72	3.59	(→) 0.49	91.64	104.73
1973-74	•	•	•	95.95	4.83	(→) 0.46	90.66	103.61
							Total	785.56
								777.02
								762.49

* Col. (5)=Col. (2) — Col. (3) + Col. (4).

@ Col. (6)=Col. (5) multiplied by 8/7.

APPENDIX 14.2

(Paragraph 14.2-17)

CONCEPT AND DEFINITIONS OF TERMS USED IN IRRIGATION STATISTICS

1. *Irrigation requirement* : The quantity of water, exclusive of precipitation, that is required for crop production. It includes economically unavoidable wastes.
2. *Net area sown* : This is the total of area sown with crops and orchards counting areas sown more than once in the same agricultural year only once.
3. *Total cropped area or gross area sown* : This is the sum of areas under all crops and represents the sum of net sown area and area sown more than once in the year.
4. *Intensity of cropping* : This is the ratio of gross (total) area sown to the net area sown expressed as a percentage.
5. *Net irrigated area* : This is the total area irrigated, counting area irrigated more than once on the same land in an agricultural year, only once.
6. *Gross irrigated area* : This is the total of irrigated area under various crops during the year, being the sum of net irrigated area and area irrigated more than once in the same year.
7. *Intensity of irrigated cropping* : This is the ratio of gross irrigated area to net irrigated area, expressed as a percentage.
8. *Crop irrigation ratio* : This is the ratio of irrigated area under a crop to the total area under the same crop expressed as a percentage.
9. *Gross command area (GCA)* : The total area (including unculturable area under habitation, roads, tanks, wastelands etc.) covered by a specific irrigation project.
10. *Culturable command area (CCA)* : This represents the culturable area in the gross command area.
11. *Intensity of irrigation* : This is the gross irrigated area in an agricultural year expressed as a percentage of the project's culturable command area.
12. *Tanks* : Pre-Independence storage schemes which were designated as tanks in irrigation statistics. Those which irrigate more than 1,600 hectares net should be classified as large tanks and the rest as small tanks.
13. *Major irrigation schemes* : All surface water schemes having a CCA of less than 10,000 hectares.
14. *Medium Irrigation Schemes* : All surface water schemes having a CCA of less than 10,000 hectares but more than 1,600 hectares come under the purview of medium irrigation schemes.
15. *Minor irrigation schemes* : The classification of irrigation schemes as minor, introduced since the beginning of planning era, has been based on different criteria viz, cost criterion during the Five Year Plans and physical criterion for the pre-Plan schemes. The cost criterion has been further subject to the proviso that the scheme should also have an independent water source. Any scheme catering for alterations or extensions in the existing major-medium schemes does not come under the purview of minor irrigation. The criteria adopted for the purpose during different periods are as indicated below :

- (i) *Pre-plan period* : Pre-plan schemes irrigating individually 1000 hectares or less come under the purview of minor irrigation schemes.

- (ii) *Beginning of First Five Year Plan to March 1965*: Schemes individually costing less than Rs 10 lakhs come under the purview of minor irrigation schemes.
- (iii) *April 1965 to March 1970*: Schemes individually costing less than Rs 15 lakhs come under the purview of minor irrigation schemes.
- (iv) *With effect from April 1970*: Schemes costing individually less than Rs 25 lakhs in the plain areas and less than Rs 30 lakhs in the hill areas come under the purview of minor irrigation.
- (v) *Now recommended*: Schemes having a CCA of 1,600 hectares or less.

16. *Storage schemes*: Storage schemes include tanks and reservoirs which impound water of streams and rivers for irrigation purposes.

17. *Diversion schemes*: These schemes include tanks and reservoirs which irrigation by mere diversion of stream water supply without arranging any storage. They consist of weir (called 'anicut' in the south, 'bandhara' in Maharashtra and Gujarat and 'thingal' in Manipur) constructed across the stream for raising and diverting water and a canal system to carry the diverted water to the fields. The channel carrying water is also known by various names in different regions. It is called, 'Khul' in the hilly areas, 'pyne' in Chhota Nagpur (Bihar), 'dong' in the Assam region, and 'low khong' in Manipur.

18. *Public surface water lift irrigation projects*: In regions where the topography does not permit direct flow irrigation from rivers or streams and lakes, water has to be lifted through pumping. Lift irrigation projects comprising pumping plants installed on rivers, streams or lakes and conveyance and distribution systems, executed and operated by Government come under the purview of public lift irrigation projects.

19. *Private surface water lift irrigation schemes*: Private pumping installations and distribution system by individual or group of farmers on surface water sources fall under the category of private lift irrigation works.

20. *Tubewells (including bore Wells and Filter points)*: Tubewell essentially consists of a deep bore drilled into ground with the purpose of tapping ground water through one or series of permeable layers of water bearing strata. Tubewells drilled in the predominantly hard rock areas, where the bores can stand on their own and where lining by blind pipes is not necessary, are called bore wells. Generally, strainers are not provided in bore wells.

Small diameter shallow tubewells installed in the soft alluvial formations or the coastal regions are called filter points. The artesian/sub-artesian wells in which water rises higher than the water table in the upper strata also come under the purview of the tubewells.

Tubewells operated and maintained by the State departments, public corporations, cooperatives societies or on community basis come under the purview of public tubewells and others owned by individual farmers as private tubewells.

21. *Dugwells*: As distinguished from tubewells, dugwells comprise open surface wells of varying dimensions, dug or sunk from the ground surface into the water bearing stratum to extract water for irrigation purposes. Usually three types of wells are constructed : (a) masonry wells; (b) wells in rocky sub-strata; and (c) kutcha wells.

15

AGRARIAN REFORMS

1 LAND REFORMS POLICY

Pre-Independence Land Tenure System

15.1.1 The East India Company inherited from the Moghul land revenue administration various types of land tenures and rights in land. These constituted a complex pattern of land relations with many local variations. In all these cases the State occupied the position of a super landlord. The rights and obligations of each category of tenure holder were sought to be defined under this system. The Zamindars, Jagirdars, Inamdar and the like held land on the condition that they fulfilled their political and administrative responsibilities and also functioned as rent collectors. In practice, however, they became the owners of land allotted to them. It was from amongst this class that a powerful landed aristocracy developed which entrenched itself firmly in the agrarian society. The peasants enjoyed certain traditional rights and they were the virtual owners of the lands they cultivated. They enjoyed hereditary occupancy right with transferability. Rents were fixed at the customary level and were not enhanced under normal conditions.

15.1.2 The British administration adopted, modified or transformed the prevailing land tenures. They made various experiments in the field solely for revenue maximisation. The British introduced two main systems, *i.e.* zamindari and the ryotwari systems and the actual cultivators were deprived of all their traditional rights. This process continued till 1793 when the Permanent Settlement was introduced with the objective to restore some order in the prevailing chaos. Proprietary rights were bestowed on the zamindars and revenue demands were fixed in perpetuity under that Settlement. No fixation of rent was provided for, nor were occupancy rights protected.

15.1.3 This idea of Permanent Settlement soon fell into disrepute as it did not ensure the flow of ever increased revenue. The very

idea of making settlements with the landlords began to wane. A more remunerative and stable land tenure system ensuring increasing revenues and some measure of stability to agricultural production, was found in the so-called ryotwari system, which was introduced in Madras and Bombay in the early part of the nineteenth century.

15.1.4 The land tenure systems so imposed were only variants of feudal and semi-feudal landownership in the interest of the colonial ruling class. India had its own variant of traditional feudalism based not on serfdom or slavery but on peasant cultivators paying rent and performing certain customary services for the landlords. Unprotected tenancies developed on a big scale. Money lending also played a big role in uprooting the small peasants from the land.

15.1.5 Land reforms under the British rule had a very limited scope and content and were motivated not by considerations of improving production, nor by a sense of social justice but by the need to safeguard British political influence and save the rural market from being completely pauperised. The most important piece of legislation with regard to any reform was the Bengal Tenancy Act, 1885.

15.1.6 The agrarian society thus structured remained powerfully dominated by big feudal and semi-feudal landowners. It remained a backward medieval type of society hidebound and restricted by archaic landlord—tenant nexus, ancient caste systems and by old traditional customs, social habits and modes of thinking. It continued as a constantly crisis ridden system having no scope for the generation of new productive forces. Agricultural production was very low marked by backward technique and colossal wastage of labour and diversion of agricultural surplus into non-productive channels. All these created a socio-economic set up in which parasitism flourished, concentration of land in the hands of rural rich continued to increase and landlessness and land hunger of the peasants mounted at an ever increasing pace. Evictions and insecurity of tenancy and rack renting became a general phenomenon and the cultivators were ground down by a heavy burden of indebtedness.

Evolution of Policy

15.1.7 A strong public opinion, therefore, crystallised to the effect that these conditions were the main hurdles in the path of national economic regeneration. The attainment of national freedom created the essential preconditions for restructuring the agrarian economy and putting it on the path of progress and accelerated development.

15.1.8 The Indian National Congress made its first positive

declaration regarding land reforms at its 45th Session (March, 1931). Subsequently, in December, 1936, it drew up a more specific agrarian programme. Thereafter, the National Planning Committee which was constituted in 1936, recommended in 1945 that all agricultural work including cultivation should be organised on cooperative and collective lines and that intermediaries between the State and the cultivators be eliminated and all these rights and titles should be acquired by the State paying desirable compensation. The Committee also opined that while the existing land revenue system lasted the basis of taxation must be changed on the model of Income-Tax.

15.1.9 In the immediate postwar period a special committee was appointed by the Congress in 1947 to work out the main lines of Congress economic policy. This committee, while reiterating the suggestion of the National Planning Committee, recommended that the maximum size of a holding should be fixed and that the surplus land over such a maximum acquired and placed at the disposal of co-operatives. Also the small holdings should be consolidated and further fragmentation prevented. Thereafter, the Congress Agrarian Reforms Committee (Kumarappa Committee) made for the first time a detailed survey of the agrarian relations in 1949 and made comprehensive recommendations covering almost all the major issues relating to land reforms. The approach of the Kumarappa Committee exercised a considerable influence on the evolution of the land reforms policy in later years. While many of its recommendations were on the lines of earlier committees, it rejected the concept of capitalist farming and disapproved the general extension of State farming. It stressed that there should be a ceiling on the size of holding which any one farmer should own and cultivate and favoured individual peasant farming as the general pattern of agrarian society.

15.1.10 Land reforms policy was concretised at the topmost Governmental level for the first time in the First Five Year Plan. The Plan acknowledged the achievement in the abolition of intermediaries and emphasised high priority for agricultural production, diversification of agricultural economy and a land policy to reduce disparities in wealth and income, eliminate exploitation, provide security for tenant and worker and promise equality of status and opportunity to different sections of the rural population. Regarding tenanted lands, it considered a rate of rent within one-fourth or one-fifth of the produce as fair. It commended the principle of fixing an upper limit on individual holdings and allowed resumption of land from the sharecroppers for cultivation by members of the family of landowners upto three family holdings. It was ensured, however, that displaced tenants had a minimum holding for cultivation.

15.1.11 The question of ceiling on land holdings, however, remained in the background during the first few years in the belief that higher agricultural production was possible only through large scale farming using modern techniques. In subsequent years, however, this question continued to gain ground as the pressure of population on land grew and landlessness among the agricultural population increased while the land distribution pattern remained highly uneven and socially inequitable.

15.1.12 The objectives of land reforms as laid down by the Second Plan were, therefore, to remove such impediments to agricultural production as arose from the agrarian structure and to create conditions for evolving an agrarian economy with high levels of efficiency and productivity. The thinking of the planners (of the Second Plan) was greatly influenced by the recommendations of the Panel on Land Reforms set up in 1955, which marked an important stage in the evolution of land reform policy. The Second Plan stressed on the abolition of landlord-tenant nexus and pointed out the large variations in the degree of practical implementation of tenancy reforms in different regions. It also referred to the large scale eviction of tenants and the "voluntary surrenders" on grounds of resumption for personal cultivation. The Plan admitted that malafide transfers of land to circumvent ceilings on holdings had taken place and recommended that these cases be reviewed and the question be considered whether the ceiling should be determined as if the transfer had not taken place. The Plan proposed steps to impose ceiling on agricultural holdings, laid down certain gradings of resumption and reiterated that rents be regulated as already recommended in the First Plan. The Second Plan, however, favoured the exemption of certain categories of farms from the operation of ceiling laws.

15.1.13 The Third Five Year Plan reiterated the policy outlined in the first two plans and generally stated the ideal of setting up a 'Socialist pattern of society' and of 'eliminating all elements of exploitation and social injustice within the agrarian system.'

15.1.14 The Fourth Five Year Plan acknowledged the gaps between the objectives and legislation and between the laws and their implementation. It noted that there had been considerable leasing out of land and in view of the insecurity of the informal tenancies neither the tenants and sharecroppers nor the landowners were willing to invest in land to improve production. The Plan, therefore, recommended that (i) all tenancies be declared non-resumable, (ii) resumption cases be finalised early where already allowed, (iii) voluntary surrenders be regulated, (iv) complete security of the tenants in their homesteadlands be assured, (v) legislation for security of

tenants and sub-tenants be properly implemented, and (vi) penalties for wrongful evictions be provided in the laws. The Plan further stressed that Government should take *suo moto* action in the matter of *mala fide* transfers and that the ceiling laws should be reoriented for better effect.

15.1.5 Following the Chief Ministers' Conference in 1970, a Central Land Reforms Committee, was constituted to consider all aspects of the question relating to ceiling on holdings. Its recommendations were further examined by another high powered 'nine member' committee. The recommendations of the Central Land Reforms Committee were considered in the Chief Ministers' Conference on Ceiling on Agricultural Holdings held in July, 1972. By a general consensus the policy on ceiling was formulated and the 'National Guidelines' were thereafter laid down which are still effective.

15.1.16 The Draft Fifth Five Year Plan formulated against this background, summed up the situation to the effect that "the laws for the abolition of intermediary tenures have been implemented fairly efficiently, whilst in the fields of tenancy reform and ceiling on holdings, legislation has fallen short of the desired objectives and implementation of the enacted laws has been inadequate". The Plan adopted a realistic approach in the context of the gaps between policy, legislation and implementation and recommended certain immediate steps. These include speedy and effective implementation of measures recommended in the earlier plans within a firm time-bound programme; prompt enactment and implementation of ceiling provisions by the States as accepted in the Chief Ministers' Conference to bring about uniformity; redesigning the programme of consolidation which should be made effective after ensuring security of tenure, particularly to the sharecropper; updating records of tenancies and their maintenance; gearing up of the administrative machinery and making the beneficiaries familiar with the provisions of laws; and associating them with implementation through local Committees. The Plan also made certain policy recommendations relating, *inter alia* to personal cultivation, leasing out, distribution of surplus land, consolidation of lands of the new allottees into compact blocks and jurisdiction of laws in the matter of implementation of land reform measures.

15.1.17 The land reforms policy since Independence has undergone a radical change and has acquired a new content and direction. The policy is indicative of the aspirations of the Indian people for basic institutional structural changes. Unless the agrarian society is regenerated and converted into a dynamic and rapidly growing system,

both the base and super structure of the national economy will remain weak and unstable.

2 LAND REFORMS LEGISLATION AND IMPLEMENTATION

15.2.1 Land reforms came to acquire an important place in the ideology of national reconstruction for economic, social as well as political reasons. Legislative enactments for land reforms during the last two and a half decades have been embodied in a programme for (a) abolition of intermediary tenures; (b) tenancy rights; (c) fixation of ceilings on land holdings; and (d) consolidation of holdings. The last mentioned aspect has been dealt with in the next section.

Abolition of Intermediaries

15.2.2 Legislative measures for the abolition of intermediaries were initiated soon after the attainment of freedom. These measures were, however, assailed on two major grounds. Firstly, the high rates of compensation led to a wastage of capital resources as the bulk of compensation was either frittered away in consumption or spent on buying urban property, etc. and only a very small percentage of it was recycled to step up agricultural production. Secondly, the exclusion of *sir*, *khudkasht* and *has* lands from the purview of the Acts as personal property of the intermediaries under self-cultivation constituted a damaging loophole in the law and was utilised with deadly effect by the intermediaries. These provisions negated in a considerable measure the beneficial effect of the legislation and helped to keep alive the social and economic base of feudal vested interests in the country. The bigger landowners got the opportunity to carve out their own *sir* and *khudkasht* lands, both in respect of location and area, and resorted to large scale eviction of tenants and sharecroppers. The mass evictions exercised a baneful effect materially and morally on village life and foiled largely the new hopes and aspirations generated among the rural poor by land reforms. However, the abolition of statutory landlordism covering a variety of intermediary tenures has now more or less been accomplished bringing nearly 20 million cultivators into direct contact with the State.

Tenancy Legislation

15.2.3 The specific features of tenancy legislation arise from the basic framework of land reforms policy which favoured neither

the wholesale expropriation of landlordism nor the wholesale expropriation of tenant cultivators. The middle course was adopted. During the first phase of the post-Independence land reforms, certain amendments to the then existing tenancy laws were carried out, along with legislation for abolition of intermediaries, extending the scope of protection to the tenants of ex-intermediaries particularly in areas of statutory landlordism. The provision of a larger measure of protection to tenants, however, set into motion a contradictory social process, namely that of mass eviction of tenants and sharecroppers. So powerful was the eviction drive, that in the years immediately following the abolition of intermediaries, the old tenancy arrangements broke down and it took years for new arrangements to take shape.

15.2.4 Most of the States, however, tried to enact or amend tenancy laws in the subsequent ten years and tried to plug certain glaring loopholes in the existing enactments to enlarge the area of protection to the tenants. The major aspects incorporated in tenancy legislation in different States during the last two and a half decades can be identified as (i) security of tenure; (ii) termination of tenancy; (iii) resumption for personal cultivation; (iv) surrenders; and (v) regulation of rent. Tenancy reforms in different States exhibited considerable variations though maintaining a broad similarity of pattern.

15.2.5 While considerable progress has been made in the field of tenancy reform many deficiencies still persist in the laws. The definition of the term 'tenant' generally excludes the sharecroppers who form the great bulk of the tenant cultivators. Most of the leasing is done in the form of sharecropping in all the States and the exclusion of sharecroppers from the scope of protection deprives the real tillers of the soil of the protection and rights provided for the tenants.

15.2.6 Ejection of tenants from their holdings is still permissible on many grounds like non-payment of rent, failure of payment within a given period, failure to deliver share of the produce within specified time, to execute agreement, to cultivate land properly etc. This is essentially a continuing hangover of the feudal system. Total eviction from land is one of the besetting evils of the existing reforms. There is no reason why tenancy should be terminated on some of these grounds, such as failure to give notice of harvesting.

15.2.7 Voluntary surrenders, as provided in the laws, are hardly ever voluntary, and have become the biggest instrument in depriving the tenants of their due protection. Land owners resort freely to pressures and coercion to secure surrenders to get the lands vacated. The provisions included in the tenancy laws of certain States for scrutiny by and registration with the revenue authorities did not bring

about any material change in the situation. The Fourth Plan suggestion that the landowners should not be allowed to regain possession of the surrendered land, which should be allotted by government to other eligible persons, has not been acted upon by most of the States except Kerala, Gujarat, Himachal Pradesh, Orissa, Karnataka and West Bengal.

15.2.8 The right of resumption was sought to be justified as it would help to convert non-working rent-receiving landowners into owner cultivators who could step up agricultural production, the accent being on 'personal cultivation'. The term 'personal cultivation' has been so defined as to cover cultivation through hired labourers paid in cash or kind, but not as a crop share. Even personal supervision by the landowner or his family is not an essential requisite of personal cultivation. With such a definition, the right of resumption has become an instrument in the hands of the unscrupulous landowners for land grabbing, more so when the factor of personal labour does not find any place in the definition. This provision has, in fact, indirectly created an atmosphere for the growth of informal and concealed tenancies under which the actual tenant is characterised as a farm servant or an 'agricultural partner.'

15.2.9 Tenancy reforms have not yet been able to regulate rents as recommended in the Plans. Fair rents have not been defined uniformly in the State laws. Besides, it is extremely difficult to implement the provisions of fair rents in the case of sharecroppers and tenants who are not enjoying any security of tenure. For any demand or litigation for fair rents on the part of such tenants leads to their ejectment from land.

15.2.10 One of the principal aims of tenancy reforms was to convert tenants into owners of land they cultivated. This object of conferring occupancy rights on as large a body of tenants as possible did not materialise because of high rates of compensation to be paid by the tenants. Besides, the purchase of ownership was made optional in certain States.

15.2.11 The provision of acquiring occupancy right by tenants on adducing proof of continuous possession for twelve consecutive years totally negates the spirit of the principle of 'land to the tiller; because under the peculiar character of landlord-tenant nexus in India, it is virtually impossible for an ordinary tenant to prove it. In fact, the landlord takes good care that the tenant is unable to do so by manipulating land records, withholding rent receipts and rotating the tenants yearly from plot to plot. The burden of proof being on the tenant, the law thus becomes virtually ineffective. It should have been provided that once a tenant puts forward his claim

to occupancy right or any right under the tenancy law, the burden of proof to the contrary should be on the landlord in order to protect the mass of tenants.

Ceiling Legislation

15.2.12 The imposition of ceiling on agricultural holdings is pre-eminently a redistributive measure. The almost compelling case of land ceiling arises from the absolute and permanent shortage of land in relation to the population dependent on it, the limited prospect of transfer of population to non-agriculture and the need to step up production along with increase in employment. But this necessity was not effectively transformed into spearheaded action. The First Plan made a passing reference, the Second Plan recorded a little advance by recommending ceiling legislation and the Third Plan only reiterated the earlier objective. Thus, for nearly fifteen years after attainment of freedom, ceiling on big holdings remained a nebulous item in the scheme of agrarian reforms. It remained until about 1960 a vague politico-economic concept lurking in the background. It was justified on consideration of social justice but not on grounds of increasing production and developing agriculture.

15.2.13 Ceiling laws were enacted and enforced in two distinct phases, the earlier phase covering the period up to 1972, and the later from 1972 after the adoption of 'National Guidelines'. As ceiling legislation is a State subject, each State enacted its own ceiling law which obviously gave room for variations. There were two units of application, namely, the individual landholder and the family. Again, the definition of the term 'family' as also the classes of land which were exempted from the operation of ceiling laws also varied widely in the States. These legislative measures were also full of loopholes and the big landowners took full advantage of them to circumvent the laws. They resorted to partition of their holdings and fictitiously transferred them to other individuals through what is called '*benami*' transfers on a very large scale in anticipation of ceiling laws with the result that very little surplus land became available for redistribution. Besides, implementation was extremely unsatisfactory. The absence of any penal measure to restrict or control such breaches of law accelerated such evasion.

15.2.14 Of the major loopholes that existed in the ceiling laws of the first phase, the high ceiling limits, scope for manipulations and clandestine transfers and exemption of various types of land from the ceiling laws were more serious. These loopholes provided an abject lesson for today. It is now generally recognised that if redistribu-

bution of land was the main objective of the ceiling laws, this was not realised at all. The ineffectiveness of the ceiling laws of the earlier phase, the exigencies of agricultural production, agrarian unrest in the country, all these factors called for immediate review. The National Guidelines formulated on basis of this review provided the basis of ceiling legislation in the post 1972 phase.

15.2.15 The ceiling legislation in the post 1972 phase has been improved, rationalised and put on a more or less uniform basis throughout the country. This represents a national consensus on the question. The ceiling limits have been appreciably reduced, the long list of the exempted categories of land has been considerably cut and measures to control clandestine transfers have been provided for. There, however, still remain some variations in the amending legislation from State to State relating to the level of ceiling on lands with assured irrigation, outer limits of ceiling, rates of compensation and the date of retrospective effect. The main problem now is that of effective implementation of the amending legislation.

Implementation

15.2.16 The ruling circles depended primarily on legislation as the instrument of agrarian reforms to the serious neglect of implementation. They believed that once legislation has been enacted the required socio-economic results would follow automatically. In fact, implementation lag in the field of land reforms is still colossal and has been almost chronic.

15.2.17 Various Plan Reports and other documents including several evaluation reports have enumerated what they considered to be the main causes of faulty or ineffective implementation. The lack of political will has been a key factor behind ineffective implementation. The enforcement of land reforms has been treated as the sole responsibility of certain administrative agencies without a time-bound programme and without any obligation on their part to associate the peasants with the process of implementation. Implementation is in a large measure a function of the degree of consciousness and organisation of the potential beneficiaries. The absence of links between the State and the potential beneficiaries through local popular organs has perpetuated the drift in the process of land reforms. The up-to-date records of rights, so crucial for effective implementation, were also wanting. Besides, the influential landowners made use of the existing laws and certain implementation procedures to get the land reform measures invalidated or stalled through judicial pronouncements and decrees.

15.2.18 So, with all the moderate stance of land reform legislation in India, the performance, by and large, has been disappointing. Since land reforms involve certain basic structural changes in rural society affecting property rights in land, the officials cannot on their own function as a change agency in this field. In fact, the official machinery has not been conditioned to act as such, and without a powerful will of the State, explicitly defined and forcefully asserted from above, land reform programmes in the hands of officials alone would continue to fail. In this situation participation of the potential beneficiaries in the practical process of implementation assumes even greater significance. The Draft Fifth Five Year Plan has, therefore, observed that a great deal more could be achieved in the field of implementation if there was dynamic, firm and unambiguous political direction and the work, was entrusted to hand picked officers.

3 AGRARIAN STRUCTURE AND PERSPECTIVE

15.3.1 The impact of land reforms on the emerging agrarian structure with their bearing on agricultural productivity, economic growth and social justice is of pivotal significance to any discussion of the problem of reorganisation of agriculture. Agrarian social structure is conditioned essentially by the extant character of property structure in land resulting in a net work of production relations and the broad socio-economic framework within which production is carried on.

Pre-Independence Agrarian Structure

15.3.2 The agrarian social structure in pre-independence period presented a decadent semi-feudal order with wide inequalities and multiform exploitation of the mass of cultivators. There was high degree of concentration of land ownership at the top. Extensive leasing out and leasing in of land was a major mode of production. The feudal and semi-feudal land-owners did not constitute a homogenous category. Despite the economic, social, caste and cultural differentiations that existed among them they maintained their collective class identity by a common pattern of exploitation of tenant cultivators. Their investment in land was meagre.

15.3.3 In spite of the feudal and semi-feudal relations, peasant proprietorship also constituted a big sector of agrarian economy. The self cultivating peasant proprietors were also far from being a homogenous class. Differentiations based on size of holdings, eco-

conomic status and caste composition were widely prevalent amongst them. Nonetheless, they developed their collective identity on the basis of a common mode of self-employment on land. On the whole, they constituted a social category distinct from the big landowners on the one hand, and tenant cultivators on the other. As small and medium landowners, they had a depressed economic status.

15.3.4 The contemporary agricultural labourers as a class comprised of persons divorced from land ownership and dependent for their livelihood mainly on field labour, did not register much growth. Wide-spread prevalence of tenancy, subsistence farming and general underdevelopment of commercialised agriculture tended to keep even the lowest strata of cultivators tied down to land and obstructed the development of an independent labour market in the countryside. This agrarian social structure tended to perpetuate a backward medieval type of agriculture which kept Indian agrarian economy in a state of stagnation for decades. In fact, that society impeded the development of forces of production and the productive enterprise of the great bulk of farmers.

Emerging Agrarian Structure

15.3.5 Indian agriculture is in a stage of transition from a predominantly semi-feudal oriented agriculture characterised by large scale leasing out of land and subsistence farming to a commercialised agriculture assuming the character of market oriented farming. The emergence and growth of commercialised agriculture, however, prevails more in areas where agriculture is technologically more developed. It is almost absent in the eastern region of the country where agriculture is far less developed and where old type of tenancies still persist.

15.3.6 Another important feature of the agrarian structure is the emergence during the last two decades or so of a class of modern entrepreneur farmers who are substantial landholders and cultivate their lands through hired labourers and with new technique. They have grown notably in certain well defined areas where material factors are favourable for modernised cultivation. They are drawn largely from the ranks of ex-semifeudal landlords, upper strata of privileged tenants, bigger ryots, moneylenders and merchants and various other categories of substantial owners.

15.3.7 The third major feature of the emerging pattern of socio-economic relations is the persistence of the numerical weight of petty peasant proprietors, who contribute the bulk of the labour force needed for agriculture. This mass of small and marginal farmers alongwith a sizeable number of middle peasants constitute the vast base of Indian

agriculture giving the agrarian economy the general character of a petty peasant proprietor economy. This big mass has grown over the years under the impact of various influences including the decay of semi-feudal relations, growth of commodity production and development of market economy, changes in proprietary rights consequent to land reforms etc. This class is becoming more market oriented and has developed powerful urges for adopting better methods of cultivation and securing more inputs, credit and irrigation. As a class or a category, which has not much weight or social influence in rural society, these peasants have hitherto failed to secure adequate means to improve their methods of cultivation. They dominate the agrarian scene numerically, but their weight in the property structure is far less due to paucity of land in their possession. In fact, one of the major negative features of agrarian transition in India is the continued concentration of land in the hands of the upper strata of the rural society.

15.3.8 Concentration of land in the hands of the big landowners has not undergone any perceptible change during the last two decades despite land reforms. The data from the Eighth and Seventeenth Rounds of National Sample Survey (NSS) provide comparable figures for ownership holdings and leased area. The Eighth Round data show that 2.64 per cent of the households belonging to the size groups above 30 acres (12.14 ha) own 28.05 per cent of area. The corresponding figures according to Seventeenth Round data of the same size group were 2.25 per cent and 22.91 per cent respectively. The Agricultural Census Report, 1970-71, shows that this size group constitutes hardly 4 per cent of the total holdings and operated 30.5 per cent area. The concentration of land in the hands of the more affluent farmer, therefore, continued to be intact. Leasing in by the affluent farmers is also a predominant phenomenon.

15.3.9 Another outstanding development in Indian agrarian structure is the rapid growth in the number of landless agricultural labourers dependent for their livelihood mainly on the sale of their labour power. They constitute about 30 per cent of the agricultural population and contribute about 40 per cent of the labour force needed for agriculture. This class is drawn either from the small and tiny peasant uprooted from the soil due to various economic and non-economic compulsions, or from the class of semi-feudal tenants, sub-tenants and sharecropper having no right in land and compelled to sell their labour power under adverse conditions. A small fraction of this class still owns tiny plots of land but is loosing them fast because of economic compulsions. The great bulk of this sector is employed as casual labourers in the lands of the big landowners and

rich and middle peasants, and for certain operations even on the holdings of small peasants. A section of them leases in tiny plots of land and works partly as sharecroppers. This class is still subject to various types of economic bondage and social oppressions.

15.3.10 The features of Indian agrarian economy thus reveal the existence of three distinct sectors of Indian agriculture, co-existing but also contending with each other. The first sector is the developed sector of modern entrepreneur farming by rich peasants. This sector is primarily based on capitalist mode of production with employment of wage labour, investment of capital, use of machinery and scientific inputs for commodity production as in industry. This sector is the main beneficiary of all governmental aids, plans and projects for agricultural development and exercises considerable influence and control over agricultural prices. It, however, is not a "pure" capitalist sector because these who dominate it combine capitalist forms of production with various remnants of pre-capitalist forms, such as leasing in and leasing out of land, sharecropping, money lending etc.

15.3.11 The second sector comprises the area under self-cultivation by medium, small and marginal farmers who have developed out of the old land tenure systems having ownership rights in land. Production in this sector is based primarily on family labour. The upper strata of this class occasionally hire in labour for certain limited processes while the labour strata hire themselves out often as agricultural labourers. The sector is thus composed of self-employed peasants whose production, though market oriented, is still primarily for family consumption and is, therefore, largely in the orbit of subsistence economy. It is generally ignored in the matter of State aids and has derived only marginal benefits from the green revolution. It has hardly any capital resources and gets meagre benefits from institutional credit agencies. This sector is the worst victim of price oscillations and is obliged to distress sales of its produce and is in a state of semistagnation.

15.3.12 The third sector is composed of vast areas of land under cultivation by sharecroppers and various other kinds of tenants and subtenants having no proprietary right in land, no security of tenure, no share in the various aids and inputs distributed by the State or institutional agencies. They are still subject to various forms of semi-feudal exploitation such as rack renting, usury, economic bondage and caste and social oppression. The present agrarian economy of India thus represents a transient and unstable equilibrium between these three sectors which are in a State of constant competition and conflict with one another.

Future Course of Development

15.3.13 The question of the future structure of Indian agrarian economy and the path of its development is a matter of primary concern of the entire national economy. Three alternative paths of development are posed before Indian agriculture, viz.

- (i) development on the lines of modern large-scale capitalist farming as in USA and West European countries;
- (ii) development on the lines of cooperative or collective farming with no private ownership as in USSR and other socialist countries; and
- (iii) development as a peasant proprietor economy based on private ownership in land, supplemented by cooperative enterprise.

15.3.14 Under the present socio-economic set up in India the first alternative has very little scope for adoption. The comparatively underdeveloped character of Indian economy as a whole imposes serious restrictions on this course of development. The money commodity relation or production for the market, an essential basis for capitalist type of production, is inadequately developed. The overwhelming majority of the landowning peasants have a deficit economy. The proportion of the marketed produce is low as the major part is directly consumed. Even in regard to the marketed produce, there is considerable gap between the value of the produce and the money fund that comes back to the producers. Considering the various liabilities the peasants have to discharge, capital accumulation in the villages is meagre. Even in respect of bigger landowners, who have considerable earnings, a good part of their savings is diverted to purposes other than investment into the agricultural reproductive sector. Thus of the total capital resources generated in agriculture, which in absolute terms are themselves meagre, only a small fraction is ploughed back into agriculture. The innumerable small and marginal farmers, whose economy has to be improved rapidly, need considerable capital investment. The diversion of funds from this direction to develop large scale farming is neither socially justified nor economically sound.

15.3.15 A more difficult and extremely complicated socio-economic problem associated with this alternative is the question of clearing up land for large-scale modern farming. The entire agricultural economy in India is numerically dominated by small and marginal farmers. Besides, there is an alarmingly large size of landless and land hungry peasantry living under conditions of chronic unemployment or under-employment. It is difficult to "clear-up" land for capitalist farming under these conditions.

15.3.16 The second alternative of development on the lines of total cooperative or collective farming is also subject to serious limitations of a socio-economic and political nature in India today. Such a system can emerge out of social and political revolutions which can transform the entire national economy in the direction of socialist ownership of property and productive resources accompanied by the establishment of a power structure to ensure maintenance and continuance of socialised property and productive relations based on it. A transformation of this nature stipulates for reaching changes in the psychology and attitudes of the property owning peasantry. The present socio-economic and political conditions are yet far from that stage of development. Any such attempt may dislocate the existing processes of agriculture without creating a better agrarian set-up.

15.3.17 The principle of cooperation will no doubt help production if applied on a big scale for providing certain essential services like irrigation, inputs, credit, marketing etc., to the mass of peasants. The process in this respect should be developed from the base upwards, priority being given to the poor, marginal and middle peasants. A concerted national drive in this direction would go a long-way towards regenerating Indian agriculture. Cooperative farming by small and middle peasants, done voluntarily, should be adequately helped and encouraged. It shall be particularly promoted in newly colonised lands where the landless and marginal farmers have been settled or blocks of surplus land available as a result of the imposition of the ceiling. State farms are suitable for large tracts of reclaimed land brought under specialised cultivation in low population density areas.

15.3.18 The third alternative is to develop as a strong and well balanced peasant proprietorship, strengthened and supplemented by co-operative and joint enterprises in specific areas of production. This course of development is the most desirable and has to be consciously planned and promoted to establish an agrarian system in which the immense labour power of self-employed peasantry is fully utilised for agricultural growth. Given the necessary conditions small farmers are no less efficient than large farms. Quite often, their returns are higher. The structure of the self-employed peasantry as a whole is weak and unstable because of a serious imbalance between distribution of landed property and labour power. This needs radical correction through the proper enforcement of land reforms and other economic measures as would strengthen their economic position for a balanced and stable growth of the entire agrarian economy. In terms of policies and institutional changes this requires the following measures :

- (i) Abolition of all remnants of feudal and semi-feudal land relationships, and domination and subjugation which

- follow such relations, through effective enforcement of ceiling laws and distribution of surplus lands;
- (ii) prevention of future accumulation of landed property in the hands of the rural rich by adopting firm positive measures;
 - (iii) implementation on a countrywide scale, of agricultural development programmes to promote to the full the production initiative and capacity of the peasantry by providing the requisite inputs and services; and
 - (iv) radical transformation of the structure of the agrarian market with such controls as would ensure remunerative and stable price to the producer and protect him from exploitation by merchant capital through price manipulations.

Recommended Structure

15.3.19 The basic objectives of land reforms should be to break-up the traditional strangle hold of the big landed interests, abolish parasitism on land and landlord tenant nexus, strengthen the overall economic position of the mass of peasants and create sanctions for the development of a healthy and dynamic agrarian society. The existing scheme of land reforms shall have to be reoriented to this end in the following direction.

15.3.20 The principle of abolition of intermediaries having been accepted the idea of continuance of tenancy under a private landowner is anomalous. Tenancy reforms should be directed to the stage of finally breaking up landlord-tenant nexus. Agriculture should be treated as a family occupation of the peasant cultivator and not as a source of subsidiary unearned income. In a normal peasant proprietor economy, there is no place for absentee landlordism, which should be discouraged and ultimately curbed.

15.3.21 There should be no leasing in or leasing out of land. The breaking up of landlord-tenant nexus, however, shall have to be done with certain qualifications. As experience indicates tenancy cannot be totally banned under the present man-land ratio until such time as socio-economic development brings about a radical change in man-land ratio, tenancy shall have to be permitted in a restricted and strictly regulated form. Leasing out of land should be permitted only in the case of marginal farmers. The period of lease should not be less than three years at a time, renewable with mutual consent. The lease should be in writing and the landowners must not be allowed to resume before the expiry of the term. Eviction of tenant from land during the lease period should be prohibited and redress of any grievance of the land-

owner should be through the court of law by means other than eviction. In the case of any eviction, the onus of proof should lie with the land-owner.

15.3.22 All tenants of landowners excepting the owners of marginal holdings should be vested with proprietary rights and simultaneously declared owners from a specified date provided that the disabled persons, minors, widows and army personnel are given some concessions. This provision shall not apply to those cases where a bigger landowner has leased in land from a small landowner. Leasing in of land by big landowners from the smaller ones should be discouraged. In any case ceiling limits should be made applicable to operational holdings as has been done in ownership holdings. The evil effects of the right of resumption being evident, the continuing right of resumption should be annulled forthwith excepting in the case of marginal farmers. The definition of 'personal cultivation' should be so changed as to prevent absentee landowners exercising the right of resumption under that garb.

15.3.23 Concealed tenancies should be detected. In case of concealed tenancy, where landlord tenant nexus is clearly established the tenant should be recorded as an occupancy tenant. Sharecroppers should be recognised as tenants and recorded as such and given all due protection.

15.3.24 'Voluntary surrenders' used to cover up forcible and illegal eviction of tenants should not be accepted as valid unless authenticated by an appropriate authority. Even in the case of a genuine surrender, the land should not revert to the landowner but to the State for allotment to any other eligible person.

15.3.25 Rents have continued to be high in many parts of the country despite the legislation. Rents above the recommended level should be curbed and controlled and the system of issuing rent receipts rigidly enforced. The tenants should be entitled to remit their rents through money orders or to deposit them in tehsil courts.

15.3.26 The prices stipulated to purchase ownership rights by the tenants have been on the higher side. It is essential that they should be reasonable and levelled down wherever higher rates prevail. The prices should be much below the market price. The tenant should be helped by the State to purchase ownership right with credit given either directly by the Government or by financial institutions.

15.3.27 Tenancy legislation cannot be properly implemented where there are either no land records or where the existing records are highly defective. The preparation of land records should, therefore, be given the top most priority in the scheme of implementation of land reforms. Tenants and sharecroppers should be promptly and properly identified

and their names recorded forthwith. The records should be kept upto-date. Pass-books showing the landownership, status and other particulars of such cultivator should be issued to him for use as an official record.

15.3.28 In view of the fact that a large number of tenants have been evicted during the last few years in anticipation of the new measures some administrative machinery should be established to consider the appeals of evicted tenants for their reinstatement.

15.3.29 The provisions of earlier ceiling laws did not make any appreciable dent in the concentration of land ownership. The new ceiling laws enacted as per 'National Guidelines' are devised to achieve this objective. The present ceilings are adequate and have been laid down on a long term basis to encourage investment in land for better production. Any attempt to lower the ceilings further may create uncertainties and is likely to undermine production. It is now necessary that the present ceiling legislation should be enforced effectively and with despatch.

15.3.30 Firm measures are, however, required against fictitious and *benami* transfers deliberately effected by big landowners to circumvent ceiling laws. The State Governments should hold proper enquiry into such transfers with the assistance of popular land reform committees. If on enquiry it is found that the transfers were made to evade the provisions of ceiling laws, the land so transferred should be vested in the State after imposition of suitable penalty on the transferer. Likewise fictitious cooperative farming societies, organised with a view to concealing surplus land, should be subjected to proper investigation. Also, where many partners have been shown in a holding under a single management, such cases should be carefully scrutinised to find out whether the partners are real or fictitious.

15.3.31 Exemption for existing plantations in respect of the actual area planted with a margin for replacement plantings may continue. But plantations should be defined clearly so that agricultural, forest and fallow lands do not escape the provisions of law. Lands held by agricultural universities or research centres should also be exempted from the operation of ceilings. But it would not be proper to allow blanket exemption in regard to land held by trusts or institutions for religious, charitable or educational purposes. Arable lands, forests and water areas held by such endowments should be brought within the ceilings.

15.3.32 There are many water tanks, particularly in the eastern region, to which ceiling laws do not apply and the State Governments exercise no control over them. These tanks are not being properly utilised either for irrigation or for pisciculture. The State should take control of such tanks for proper utilisation of water for irrigation or pisciculture as the case may be.

15.3.33 Consolidation of holdings has often led to large scale eviction of insecure tenants. Land reforms should, therefore, precede consolidation of holdings to protect the interests of tenants and share-croppers.

15.3.34 The vital objective of fixation of ceilings on land holdings is to distribute the surplus land. However, it is argued that it is not only important to fix a ceiling on holdings but also to fix a floor so that as many peasants as possible have at least a small operational holding. But in view of massive landlessness, serious lack of employment possibilites and the subsistence of almost half of the rural population below the poverty line to whom land, however, small in extent, is a source of employment and relief from destitution, the implementation of workable floor is more difficult than that of ceiling. For a long time to come a floor on ownership cannot be applied.

15.3.35 In the distribution of surplus land it, therefore, becomes imperative to give priority to the landless agricultural population, particularly belonging to the Harijans, tribals, and other backward communities to provide the largest number of landless agricultural people with a small piece of land for subsistence, the first priority being given to those who are tilling the land in any capacity. The small owners, who get together for joint farming, should be given preferential assistance by the State. The interests of the existing tenants should be safeguarded in the process of implementation of ceilings and demarcation of surplus land.

15.3.36 Where surplus land is available in large blocks, the allotment of land to cooperative societies consisting of eligible beneficiaries should be encouraged. The surplus land should be allotted to the beneficiaries on the specific condition that they would not be permitted to sell or mortgage those lands to any private individual. If at any time, a beneficiary wants to leave the profession of cultivation, the land held by him would revert to the State. Subject to that they should enjoy permanent and heritable rights. The State Government should also set up special institutions through which adequate credit and other inputs should be made available to the allottees for the development of assigned lands.

15.3.37 The inclusion of land legislation in Schedule IX of the Constitution has undoubtedly curtailed prolonged litigation and consequent undue delays in the enforcement of land reforms. But it appears that various substantive legal measures are still being challenged, on grounds like inconsistency of ceiling laws with the provisions of the Constitution, definition of family and discrimination between major and minor sons, basis for classification of land, rates of compensation etc. The law makers should consider all such legal hurdles that exist

today for their elimination.

15.3.38 Land reforms have suffered in the past not only because of certain political and economic constraints but also because of a very inadequate and inefficient administrative machinery. The existing system of trial of cases relating to land by the district, civil or revenue courts causes undue delay, makes justice costly and often results in dispensation of a doubtful nature. The establishment of special itinerant courts to dispose of cases in the villages of their origin or in the closeby townships would expedite work as they would be in the know of relationships and happenings in the field and thereby serve the ends of justice. Village panchayats or local land reforms committees can also directly help the peasants in their litigation against the landlords under that arrangement.

15.3.39 A restructuring of the entire administrative machinery for the enforcement of land reform laws is now extremely necessary. The land reform administration should be separated from land revenue administration and special land reform agencies composed of hand picked officers with proper training, ability and dedication to the cause set up. The new land reform set up should, in addition to effective implementation of land reform measures, be responsible for coordination among the various departments of rural development as is necessary to enhance the economic well being of the beneficiaries of land reforms.

15.3.40 Since enforcement of ceiling under the present judicial practice is highly time consuming, the judicial formalities should be reasonably curtailed by confining the scope of appeals to two stages only and by reducing the period of draft and final publication of records.

15.3.41 Implementation is also seriously obstructed either because of late submission of returns or submission of wrong returns by the landowners. Suitable penalties need be provided for such action and such States as have not yet provided such penalties should do so very early.

15.3.42 Land reforms cannot be properly enforced without popular cooperation and support at all levels. Popular supervisory committees should, therefore, be constituted at all levels consisting of peoples' representatives including the beneficiaries, officials and experts to exercise vigilance on implementation. These committees, should be vested with certain statutory powers like inspection of records and sites, collection of evidence, etc. and their recommendations should receive due weightage.

4 CONSOLIDATION OF HOLDINGS

15.4.1 A major cause of low agricultural productivity in India is fragmentation and subdivision of holdings. The social structure which creates a great demand for the limited land area by the population and the private law and custom have encouraged excessive fragmentation and progressive subdivision. Although the importance and urgency of the problem has been recognised long back, legislative action has been fairly recent. Consolidation of holdings is of major interest today in many countries engaged in improving their agrarian structure. Successive five year plans have laid stress on the importance of the programme of consolidation as well as integrated area development. The First Five Year Plan recognised the experience in Punjab, Madhya Pradesh and Bombay and suggested that consolidation of holdings should be expanded and pursued with vigour. The Second Plan advocated that it should be undertaken as a task of primary importance in national extension service blocks while the Third Plan recommended that it would be desirable to concentrate consolidation work in areas under irrigation or those likely to come under irrigation in view of the limitation of trained personnel. The Fourth Plan, recognising its important contribution to the agricultural development of Punjab, Haryana and Uttar Pradesh, recommended its vigorous pursuit in other States. The Fifth Plan has stressed the need for consolidating the lands of small holders, the surplus land and the government waste land available for distribution to the new assignees in compact blocks to facilitate the flow of future public investments in irrigation and land development exclusively for the benefit of the underprivileged.

Experience in India and Abroad

15.4.2 Land consolidation in India had its beginnings in the attempt to stop or restrict subdivision of fields and to prevent fragmentation when the Settlement Department of Bombay decided in 1847 not to recognise or enter plots below a certain area in the revenue records, and enter the name of the eldest son in the record of rights. Without statutory sanction, these reform measures proved ineffective. Consolidation of two villages in the Central Provinces was taken up in 1905 for the first time in India. The All-India Board of Agriculture asked the Provinces in 1917 to investigate and to adopt remedial measures for prevention of fragmentation. The Report of the Royal Commission on Agriculture (1928) was categorical regarding the correlation between prevention of fragmentation and consolidation.

15.4.3 Punjab took the lead in starting voluntary consolidation

through cooperative consolidation societies set up under the Cooperative Societies Act, 1912, and the work began in 1920. But the scheme did not make much headway due to its limited application to consenting members, voluntary nature and escape clause for abrogation. The United Provinces also took up a similar scheme but with very little progress. When the sporadic and diluted experiment was started in Punjab, the princely State of Baroda took the bold step of enacting a law for consolidation in 1920. But unfortunately it remained only on the statute book. The Central Provinces in 1928 became the pioneer in British India to enact the first legislative measure with the basic rudiment of land consolidation through voluntary effort. This was followed by the Punjab Consolidation of Holdings Act, 1936 and the United Provinces Consolidation Act, 1939. While voluntary consolidation was the keynote of the Punjab Act, certain element of compulsion was provided for in the UP Act. The provisions of the UP Act came into force in January, 1940, but the scheme made little progress owing to the lack of public support. In Punjab also, the passing of the Act made no impact on consolidation.

15.4.4 Voluntary consolidation did not make any headway in other States also. The Jammu & Kashmir Consolidation of Holdings Act was enacted in 1940, more or less on the pattern of the Punjab Act. In Kerala and the former Madras Province consolidation cooperative societies were set up in 1936 after the practice of Punjab, and Uttar Pradesh but the scheme was discontinued on the ground that consolidation was not worthwhile as long as the law of succession allowed fragmentation.

15.4.5 Compulsory consolidation replaced voluntary consolidation in almost all the States after Independence where agrarian reforms had already been undertaken. The States were too eager to hasten enactment of such measures, but barring three or four of them, there was little interest shown in implementation. Bombay passed its Act in 1947, Punjab in 1948, Uttar Pradesh and Himachal Pradesh in 1953, Rajasthan in 1954, West Bengal in 1955, Andhra Pradesh and Bihar in 1956, Madhya Pradesh in 1959, Assam in 1960, Jammu & Kashmir in 1962 and Mysore in 1966. Gujarat and Maharashtra adopted the Bombay Act of 1947, Haryana continued to follow the Punjab Act. The Orissa Act was passed in 1972. Tamil Nadu and Kerala did not adopt any legislative measure for consolidation. No measures have been enacted in Arunachal Pradesh, Meghalaya, Manipur, Nagaland and Tripura as well as the Union Territories except Delhi which has adopted the Punjab Act.

15.4.6 Consolidation legislation is highly developed in some countries of Europe and Asia. In most of the European countries

consolidation of holdings forms part of the overall framework of agrarian measures and includes provisions for prevention of fragmentation. In certain Asian countries also, like Japan, Iraq and Syria, agrarian reforms legislation provides for consolidation of land. In Iraq, there is a special antifragmentation legislation. Among the Latin American countries, only Chile and Mexico have made provisions on consolidation.

Review of progress

15.4.7 Since very few States took up implementation with any degree of earnestness, the progress of consolidation has been uneven in the country. While, separate organisations were set up for this work in Punjab, Haryana and Uttar Pradesh and the entire areas of these States were covered by the plans of consolidation, the work was done by normal agencies of revenue administration in other States with varying degrees of priority.

15.4.8 Substantial progress has been made in the States of Haryana, Punjab and Uttar Pradesh, which have plans for total coverage. Consolidation has more or less been completed or is nearing completion in Haryana and Punjab. A special feature of consolidation operations in these two States, which has no parallel in the rest of the country, is the recognition of the tenure holder's right at two levels, *i.e.*, that of the actual occupier as well as of the lessor.

15.4.9 Progress is also substantial in the States of Maharashtra and Himachal Pradesh, though total coverage is not yet contemplated. Madhya Pradesh, Gujarat and Karnataka are the States where some work has been done, while experimental work has been done in Andhra Pradesh, Bihar and Jammu & Kashmir. No progress has been made in Assam, Orissa and West Bengal though there is enabling legislation.

15.4.10 The States can be divided into the following categories on the basis of progress :

- (i) States in which substantial progress has been made and which have plans of total coverage—Uttar Pradesh, Punjab and Haryana;
- (ii) States in which substantial progress is shown though total coverage is not yet contemplated—Maharashtra and Himachal Pradesh;
- (iii) States in which some work has been done—Madhya Pradesh, Rajasthan, Gujarat and Karnataka;
- (iv) States in which experimental work has been done—Jammu & Kashmir, Bihar and Andhra Pradesh;
- (v) States in which no progress has been made though legisla-

- tion has been passed—West Bengal, Assam and Orissa; and
 (vi) States in which legislation has not so far been enacted—
 Tamil Nadu and Kerala.

Land Consolidation in Socio-Economic Background

15.4.11 A major impediment to efficient cultivation is the fact that agricultural holdings generally consist of small scattered fields lying at considerable distances from one another. By the custom of dividing landed property amongst heirs, the successive generations descending from a common ancestor inherited not only smaller and still smaller shares of land, but also land broken up into smaller and tiny plots. The problem of excessive fragmentation of farms is different from that of small and uneconomic size of farms. But they are vitally inter-linked as each aggravates the drawbacks resulting from the other. The problem of excessive fragmentation has also to be considered in the context of high percentage of the small sized average holdings in India. Surveys in certain States have shown a definite decrease in the average size of the holdings. The all India picture which is not very encouraging, reveals that a large proportion of rural households is either landless or holds tiny plots and that a large proportion of land is covered by small holdings. As a balancing factor to the ceiling on holdings, a programme for improving the farm structure and achieving a rapid rate of farm amalgamation becomes an imperative necessity.

15.4.12 The problem of fragmentation has also to be tackled, to the possible extent, as a counterpart of consolidation without which the advantages of consolidation will be neutralised over time. Legislation incorporating such provisions was enacted in some States, but it could not be enforced with any amount of vigour because of certain practical difficulties, like the definition of a fragment. While no uniform definition of fragment is practicable, the transfer of a portion of land resulting in fragmentation should be regulated to discourage creation of new fragments. Partition of a plot resulting in a fragment should normally be prohibited. Transfer by sale etc. should be permissible only to contiguous cultivators in order of preference as follows :

- (i) Collateral of the transferer if he is the contiguous tenure holder; in case of more than one such collateral, the order of precedence in succession as prescribed in the Hindu Succession Act, will prevail; and
- (ii) in other cases the preference will be in the ascending order of holding's size of the contiguous tenure holder.

15.4.13 The State Government should also assume the right of pre-emptive purchase. Some mechanism of fixation of fair price should

be evolved to see that such regulations do not peg the price to the detriment of the alienator.

15.4.14 In the areas where underground water potential fit for irrigation exists and holdings with more than one block had been carved out as a result of consolidation, they may be reconsolidated to create one block holdings where the needs of irrigation call for such action.

Principles and Techniques of Consolidation

15.4.15 The voluntary scheme of consolidation having proved ineffective and the compulsory scheme being highly successful, the scheme should be made compulsory in all the areas of the country fit for consolidation. For proper implementation, comprehensive, self-sufficient, procedural legislation is essential. Considering certain basic drawbacks in most of the State legislation, the following criteria should be kept in view in framing legislation on consolidation :

- (i) The consolidation law should be independent of Central or State laws relating to ownership, disposal and other treatment of agricultural land but should not contain anything contrary to the land policy laid down in other substantive laws.
- (ii) It should be drafted in simple language using locally prevalent terms.
- (iii) The law should provide direct dealings with the holders of land and the officials should be in contact with the cultivators and decide disputes by reconciliation with the contending parties. The programme should be discussed intensively locally and the procedure should be understandable to all concerned for inspiring confidence in the villagers about the work.
- (iv) The legislation should clearly provide for determination of value of land, drawing up of the consolidation scheme and reservation of areas for common village needs in consultation with the people, measurement of fields and preparation of record of rights by the field staff.
- (v) While consolidation is taken up, the land of the small and marginal farmers, sharecroppers and the surplus and waste land available for distribution should be consolidated in compact blocks to facilitate the flow of public investment for irrigation or any other development project.

15.4.16 Consolidation operations should be time-bound. A time limit should be fixed for completion of every stage including the disposal of cases. The law should envisage at least one and not more than,

two remedies for redress of grievances against the Court of first instance. Unless reasonable time limit is also fixed for disposal of writ applications filed in High Courts, expeditious completion of the work cannot be ensured. Writs relating to consolidation should be disposed of within six months from the date of filing. Title cases including correction of records or maps tried in civil or revenue courts also delay the completion of operations. All such pending cases should abate and be disposed of in consolidation courts which alone should have jurisdiction to decide such cases till the operations last.

Procedures

15.4.17 The procedure of consolidation varies from State to State depending upon the socio-economic conditions, land tenure system, lay-out of holdings, their sizes and dispersal, variations in soils and other factors. There are various stages of consolidation operations.

15.4.18 Chronologically, the different stages are broadly the initiation of operations, formation of advisory committees; correction of records and maps; settlement of disputes of title; valuation of land for purpose of exchange; statement of principles; reservation of land for common purposes; coordination between consolidation and other departments; framing of the consolidation scheme, its preparation, publication and confirmation; transfer of possessions; revision of records, preparation of new records of rights; and denotification of the area under consolidation.

15.4.19 Advisory committees should be set up for guiding policy at three levels—the State, district and village. While the committees at the State and district levels will have advisory functions, the village committees should have an important role of decision making and implementation also—e.g., in setting apart land for common uses and in outlining the principles for framing of and carving out new consolidated holdings.

15.4.20 Any scheme for exchange of land must necessarily involve its valuation to ensure that each party gets an equitable deal. Of the three prevalent methods of valuation based on productivity, market price and rental value, the method of valuation based on productivity is considered to be the most equitable one and should be adopted uniformly. Valuation should be communicated in writing to the persons concerned through pass books and published in the village.

15.4.21 Certain areas of land are deducted as contribution by the tenureholders in proportion to their holdings for planning and development of villages in Punjab, Haryana and Uttar Pradesh. A similar provision of land for common purposes should be an essential feature

of consolidation.

15.4.22 The benefits of land consolidation are realised when various agricultural development programmes relating to irrigation, land reclamation, soil conservation, communications and different agro-economic facilities are undertaken to take full advantage of the scheme. The effectiveness of land consolidation in India is evident more in the sphere of irrigation. The requisite degree of emphasis on programmes which would have made a substantial impact on agricultural improvement has been lacking. It is necessary that along with rectangulation each village should be contoured and water channels proposed jointly by the consolidation and irrigation agencies. The services of an agronomist and an expert in soil conservation are also essential for the work. It would also be desirable to align soil conservation with consolidation for which joint schemes should be drawn and implemented only after consolidation has been completed.

15.4.23 The tenure holders have the same right and title in the new areas as they had on the land held previously. However, it is noticed that at a number of places some influential sections in the village have forcibly taken possession of the plots assigned to the weaker sections as habitation sites. There is no agency to restore possession to such sufferers. Revenue authorities should be empowered to restore the possession of such lands to the allottees. A major weakness of the programme was that consolidation was done without taking effective steps to ensure security of tenure to tenants, particularly share-croppers. It would be desirable that all tenants and sharecroppers are identified, their rights recorded and permanent heritable rights conferred on them before commencement of consolidation operations to eliminate the chances of ejection of insecure tenants.

15.4.24 The common village lands are generally scattered. Such lands should be consolidated at one place for production of fodder, grasses, fuelwood, developing agro-based industries etc. The land reserved for habitation sites for Harijans, landless labourers etc. should be earmarked for individuals and not set apart as a common piece of land for the entire body of the non-proprietors to be subsequently divided by the village panchayat or other agencies. This is necessary for securing loans for and expedite construction of houses.

Surveys and Record of Rights

15.4.25 Records and maps, corrected and made upto date, are essential prerequisites to consolidation operations. The topographical survey of the village as a whole by the Survey of India and the cadastral survey of every field by the settlement organisation help the preparation

of Jamabandi (periodical record of rights). The rectangulation of land, laid by Survey of India and broken into smaller units by the settlement organisation, has certain distinct advantages. It provides right holders with fields of uniform shape and size and makes it convenient and economical for irrigation and cultivation. Also, boundary disputes are minimised, crop inspections become easy and planning for the tract is made much easier. These considerations should be kept in view while suggesting rectangulation in plain areas to be brought under consolidation. Since the country has adopted the metric system, the rectangles should be formed in terms of metres and hectares. Village maps and periodical records of rights (Current Jamabandi) need immediate attention. The necessity of framing new records where regular settlement operations are due, is eliminated as the records prepared under the consolidation Acts have the same legal sanctity. To reduce the cost of regular settlement, where due, it should be undertaken immediately after consolidation.

Organisation and Administrative Set-up

15.4.26 Though consolidation of holdings is an imperative necessity, yet it would be desirable to give a modest start to the scheme in a limited area in the State on pilot basis to enable the field staff to gain in experience and to popularise the scheme by bringing home to the villagers the benefits of consolidation. Staffing pattern for this work differs from State to State. In the initial stages, dual charge may be assigned to the Director of Land Reforms for economy. A separate head of the department at State level should be appointed when the scheme acquires full momentum. The seat of the Settlement Officer should be at district headquarters for better supervision and advantage to the tenure holders. A norm of work should also be set to maintain close watch. The scope for malpractices, if any, should be rigidly controlled and eliminated by closer supervision and setting up watch dog committees consisting of farmers, landless labourers, local members of Legislative Assemblies and chairmen of the block samities. Training centres of short duration should be set up for imparting training to the staff.

Special Problem Areas

15.4.27 Consolidation of holdings did not find favour with some of the rice growing areas, particularly in the Southern States of Tamil Nadu and Kerala. They have some difficulties which need careful examination. Firstly, the holdings in most of these States are small.

Secondly, the scheme did not hold much attraction in areas where the number of fragments happened to be very small. Thirdly, the land use capability classification and consumption patterns of the local population also hamper the process of consolidation. Fourthly, valuation of land also presents a problem in the States where perennial crops like coconut, arecanut and mangoes predominate. The assessment of land in such situations becomes difficult. Fifthly, in States like Kerala where most of the cultivation depends on rainfall, the farmers do not find any special advantage in consolidation. Similarly, mechanisation or tractorisation is not a very economical proposition on small holdings, especially where perennial crops are intercropped with seasonal crops in the dry land regions. Consolidation is more difficult in such States as Kerala where village is more often an administrative rather than a sociological unit and homesteads are scattered all over the village. The consolidation scheme may be pushed there with homesteads as nuclei if differences in soil types and land use capabilities do not pose a serious problem. Multiplicity of tenurial systems and absence of upto date records also impede the work. These difficulties have to be kept in view while formulating practical schemes of consolidation for these areas.

15.4.28 In most of the paddy growing areas in southern States, a uniform cropping pattern exists in large tracts. These areas present ideal conditions for demonstrating the utility of consolidation. The "Yela" programme in Kerala is a good example of how agricultural operations can be performed successfully through consolidation and co-operative activity. There is now greater appreciation of the benefits of consolidation as a preplanned sequel to the implementation of land reforms.

15.4.29 Arid areas have extremely erratic, variable and low rainfall. Even so, agriculture and animal husbandry are the chief source of livelihood there. In view of the undoubtedly production of benefits and operational economy, the programme of consolidation should be taken up in arid and desert areas also. The only distinction to be made is in regard to areas under pastures and grasslands which should be devoted for best purposes.

15.4.30 In high altitudes, where cultivation is practised on shifting basis, the question of conventional consolidation does not arise. As a variation, a realignment of the field boundaries along contours, followed by terracing, is likely to yield more positive benefits. The hilly areas of Himachal Pradesh, Jammu & Kashmir and Uttar Pradesh, however, present a different situation. Each *tika* (sub-estate) has different agro-nomical conditions which determine its own production pattern. This problem should be kept in view in any scheme of consolidation.

15.4.31 Consolidation may not also be attempted in hilly areas where the scope for exchange of land is limited. Consolidation of agricultural lands in hilly areas should be supplemented with schemes of lift irrigation and gravity flows for maximising of agricultural output.

15.4.32 There is general apprehension amongst the owners of apple orchards, tea and coffee plantations etc. that they might lose valuable assets due to consolidation. The policy to treat them as separate blocks is accordingly considered to be realistic and necessary where consolidation work is taken up.

15.4.33 The riverine tracts in Punjab, Haryana and Uttar Pradesh present special problems and require advanced consolidation technology. The examination of the problems reveals that these tracts may be categorised as follows :

- (i) Sandy strip along the river bank subject to flooding and erosion, which remains submerged sometimes for years together. Such strips need not be taken up at all.
- (ii) Area next to that strip lying along the bank is usually inundated and interspersed by stretches of land fit for cultivation. Consolidation of such tract is feasible and should be attempted at the request of the landholders. Exchange of such land with higher level land should be avoided.
- (iii) Upland strip seldom subject to river action should be taken up and the tenure holders would like it.

Priorities and Financing

15.4.34 The total area still required to be consolidated comes to about 137.2 Mha. Each State shall determine the quantum of area for consolidation depending on the availability of trained staff and other sources. Priority should be given to irrigated areas and command areas of newly completed irrigation projects in the implementation of the programme. Each Legislature should pass consolidation law taking advantage of the experience gained by the States well advanced in the work. The cost has to be kept at the minimum level by taking up the work in compact units, introducing the work on compulsory basis without leaving the work incomplete. Honest, efficient and trained staff should be deployed for the work and rigid and frequent supervision should be exercised. The scheme should be taken up in areas inhabited by enlightened farmers conscious of the benefits of consolidation.

15.4.35 While adopting all avenues of economy in cost, a reasonable percentage of cost should be realised from the beneficiaries to reduce the financial burden on the State. The small and marginal

farmers should be exempted from the payment of cost of consolidation of their lands and twenty five per cent of that cost should be paid to the State Governments in the form of grant by way of Central assistance. There should be an effective machinery for periodic assessment of consolidation programmes.

5 AGRICULTURAL LABOUR

15.5.1 During the British rule, there were extensive additions to the ranks of the rural proletariat owing to forces like new land tenures, monetisation of transactions and decline of village artisans which severely impaired the balance and interdependence among the different strata in the rural society and weakened the traditional viability of rural economy. This growth was the result of disintegration and immiserisation and not of a developmental process bringing in its train occupational diversification. The problem of agricultural labourers in India has its roots in the simple but profound truth that they have carried their struggles for survival bare-handed without being able to obtain strength and succour through any of the usual means of acquiring skills, which command high wage rates, collective bargaining or State intervention on their behalf in the labour market.

15.5.2 Even during the more recent period of planned development, neither general economic development nor agricultural development nor even agrarian reform measures has led to any improvement in the level of living of the bulk of agricultural labourers as the recent estimates of proportion of population below the poverty line show. The structural measures to realign the production relations within agriculture in favour of agricultural labourers and other weaker sections and the legislative support to their wages have little to show by way of concrete results. Even the spectacular upsurge in agricultural production in the regions of 'green revolution' does not appear to have resulted in a uniform and substantial improvement in wages.

15.5.3 The problems of the agricultural labourers over the coming decades need be assessed from this sombre historical perspective. The problems are likely to be aggravated as the expected demographic additions to the labour force over the next twentyfive years will be very substantial. The expansion of non-agricultural avenues of employment is unlikely to be fast enough to provide significant relief to agriculture from the pressure of population for many decades ahead. In the absence of basic institutional reforms and effective controls to promote selective mechanisation, technological change in agriculture can easily prove to be a bane rather than a boon to agricultural labourers.

15.5.4 The problems of agricultural labourers arise not so much from the specific weaknesses and deficiencies of this class as from the basic maladjustment in the total Indian economy due to lack of fast enough growth, along with appropriate structural and technological changes. The experience shows that the strategy of "growth by any means to be followed by removal of poverty" is not a viable strategy for cohesive development of Indian society. The principal instrument for tackling these problems is the totality of planned efforts for development.

15.5.5 The need for a basic reorientation of the strategy of development does not imply that measures and programmes to reach direct at the problems of agricultural labour are now no more relevant or important; the implication on the other hand is that these measures should complement and reinforce the plan programmes rather than remain symbolic gestures of good intentions. Conceptually, they fall into three inter-related categories as follows :

- (i) measures for intervention in the labour market to support wages and improve working conditions and the long term measures to foster institutions and organisations among agricultural labourers capable of taking over these functions;
- (ii) measures to provide supplementary employment and occupation to agricultural labourers on the basis of a composite welfare-cum-efficiency criterion with a growing emphasis on the latter component of the criterion; and
- (iii) measures to ensure adequate sharing by agricultural labourers in the programmes, such as minimum needs and public consumption, specially designed for the rural poor.

Some Recent Indicators of Economic Position of Agricultural Labourers

15.5.6 The principal trends in the economic conditions of agricultural labourers during the recent years are as follows :

- (i) The level of real wages of agricultural labourers has not shown any significant improvement during the last one decade or so except in Punjab and Kerala. Real wages appear to have declined in Karnataka, Madhya Pradesh, Assam, Orissa and Gujarat during 1960-61 and 1969-70, while in other States agricultural labourers have been finding it difficult to retain the real wage rates of 1960-61.
- (ii) The average annual income of agricultural labour households has gone up, both in money and real terms. This

may be due to improvement in the availability of employment. However, even with increased household incomes, there is hardly any scope for savings. The household income and consumption expenditure are evenly balanced and the overall profile is that of the subsistence living in most of the States for which data are available.

- (iii) The non-cultivating wage earner households derive about 56 to 90 per cent of their income through wage labour and the rest from subsidiary occupations, essentially of self-employed nature. Assistance for the development of such occupations will be essential for the improvement of the level of income of these households.
- (iv) The proportion of indebted households to total agricultural labour households showed a marginal decline between 1956-57 and 1964-65. While relevant data are not available for the later period, the available data indicate that the average amount of loan outstanding per household is increasing. Loans are of the shorter duration and repayment ratio is high, especially in States where the agricultural sector has registered significant growth.

15.5.7 There is also a special class of labourers called bonded labour whose problems need special attention. The prominent feature of this system is that a man pledged his person or sometimes a member of his family against a loan. It is widely prevalent in various forms and is known by different names in different parts of the country. The problems of bonded labour have many tenacious sociological, cultural and institutional roots. The moneylenders taking advantage of the illiteracy, ignorance and indebtedness of the tribals and other backward communities, dictate their own terms as regards the interest and manipulate as to force the tribals to remain bonded for several years. Loans are taken generally to meet expenses on social ceremonies and the debtors bound themselves either by written or verbal agreements to be the labourers of the creditors as long as the loan and interest remain unpaid. In most cases the service rendered is usually counted towards interest and the debtor is merely given some food and clothing. Often the descendants of the debtors are obliged to serve the descendants of the creditors in lieu of the family debt.

Policy for Minimum Wages in Agriculture

15.5.8 Though under the Minimum Wages Act, 1948 many States have fixed minimum wages to be paid to agricultural labourers, often according to the nature of operations, the enforcement of the provisions

has not been feasible. In a number of cases the minimum wages were fixed at an initially low level more than two decades ago and have been revised only infrequently since then. This and not effective enforcement, explains the prevalence of relatively higher level of prevailing wages in some States compared to minimum wages.

15.5.9 The task of enforcing minimum wages in agriculture does not have any of the feasibility features like identifiability, enforceability and terminability as are characteristic of the organised industrial sector. It would mean regulating the wages received by more than one-third of total rural population through legislative intervention in thousands of rural communities; and the operation can hardly be regarded as terminable in any meaningful sense. The task has to be formulated in mere implementable terms and to be effective, the policy for minimum wages calls for planned and concerted efforts for enforcement in selected priority areas. In formulating the policy, the context of both wage determination and the impact of the broader developmental efforts, of which the minimum wages legislation is a part, has to be kept in view.

15.5.10 The labour market in India is complicated by the heterogeneity of both labourers and their employers and the localised nature of the market. The labour in agriculture consists of groups with varying reservation prices. At one end of the spectrum is the group of 'wage-takers' with near-zero reservation price, who must accept employment, however, low the wage. At the other is the group of 'employment-takers' which takes up employment only when the prevailing wages are at an acceptable level. The 'wage-takers' and groups close to them primarily bear the incidence of low wages.

15.5.11 The employers include a large number of small cultivators, similar in socio-economic status as the labourers, and a smaller number of those with higher socio-economic status. The responses to minimum wage legislation requiring payment of higher wages will be different for each group, the former trying to substitute 'hired' labour by family labour and the latter by machinery or capital.

15.5.12 The markets for labour tend to be less than fully linked with each other and the level and range of wages tend to vary from area to area. The regulation of wages would, therefore, require intervention in a large number of small and dispersed markets. However, the need for regulation is hardly of equal urgency throughout the entire range of prevailing situations. The right measure would be to restrict the benefits of wage regulation to 'wage-takers' and impose its burden on the large cultivators with capacity to pay higher wages. The minimum wage legislation, thus, needs to be enforced with a sense of priority in selected areas.

15.5.13 Low wages arise from the poverty of agriculture and

exploitation. Programmes for upgrading wages have to act on both the dimensions. The entire developmental effort to diversify the economy and to modernise agriculture would be the principal programme to eradicate the poverty of agriculture.

15.5.14 The programmes more directly focussed on agricultural labourers or the rural poor may be categorised broadly according to their primary objective as (a) rural employment programmes, (b) welfare programmes, (c) economic rehabilitation programmes and (d) social rehabilitation programmes. The first three types of programmes will have an indirect favourable impact on agricultural wages. The social programmes by influencing the attitudes and social status of agricultural labourers will strengthen their urge for the elimination of exploitation. The task of minimum wage legislation would be limited to the provisions of a legal framework and support to protect agricultural labourers from exploitation.

15.5.15 Effective implementation needs some degree of selectivity in the choice of areas for enforcement and realism in fixing the level of minimum wages. The range of situations falling between the two extremes of 'high wage' areas and 'low wage but poor' areas would contain areas with a good potential in terms of their needs as well as stability to enforce minimum wages. The areas in which the labourers are sharply marked off from the class of land owners/cultivators and suffer from low socio-economic status in the community should receive the first priority. They should be easily identifiable owing to prevalence of gross and observable inequities rooted in socio-economic relationship. In other low wage areas, reliance should be on indirect regulation of wages by guaranteeing adequate employment at the desired level of wages.

15.5.16 Minimum wage legislation should work for a progressive increase in the minimum level through positive programmes to eliminate the poverty of agriculture and through gradual strengthening of the enforcement machinery. The long term target of the legislation should be to ensure the need-based minimum.

15.5.17 The State Governments should set up a small group at the State level for consistent vigilance and supervision over implementation of the Minimum Wages Act. Implementation of the law may work through a committee of the panchayat aided by some functionaries appointed under the legislation. The objective of the committee would be to persuade the employers to enter into broad understandings about the level of wages. The committee could inspect the enforcement of understanding reached and devise measures to check violations. The functioning of this panchayat committee need be supervised and guided by a watch dog committee which should lay down the working procedures.

and function as an appellate body to look into grievances arising out of implementation and as a trustee of the labouring classes. Neither the legislative measures nor the local non-official initiative alone can yield a satisfactory measure of success. What is needed is a harmonious balance and integration between these two instruments so that the force of law is harnessed and put to work not by distant and inaccessible administrative machinery only, but, to a growing extent, by the local committees including the beneficiaries.

15.5.18 It is important to strengthen the official machinery for inspection, conciliation and enforcement. The recent announcements in the States of Kerala and Maharashtra for substantial modifications in their minimum wages Acts for more effective implementation are good instances. The lead given by these States should be followed by other State Governments.

15.5.19 The long term solution of the problem will depend appreciably on the effective unionisation of agricultural labourers. While this is primarily a field for local leaders and voluntary agencies, the supporting role that the State can play deserves careful consideration. The process of unionisation will support policies relating to programmes for social rehabilitation of agricultural labourers and prevention of premature and unregulated mechanisation from complicating the task of regulation of wages. As the direct enforcement of minimum wages would take time to be effective, the policy on minimum wages needs to be integrated with the employment creating programmes to influence wages indirectly by offering alternative or supplementary employment. However, the objective should not be to assign a relief-cum-welfare role to rural works programmes. Rural works programmes would play a vital role in mobilising the growing rural labour and providing them with employment in an organised manner on quasi-permanent basis. The long term objective of these programmes ought to be to generate employment opportunities within the rural section capable of transforming the rural unskilled labour into a dynamic input for capital formation and social change.

Housing Amenities and Subsidiary Occupations

15.5.20 Provision for housing and other amenities for the agricultural labourers should be given top priority. As the problem of securing of shelter and means of livelihood cannot be considered in isolation of each other, it is equally necessary to provide them with land in addition to homestead land for plying their trade. The approach has essentially to be of not making any shaded distinction between the landless and other agricultural labour but of integrating both those segments

within a common framework of development. Surplus land resulting from the ceilings on agricultural holdings should be given to them on priority basis in compact blocks to facilitate cooperative management and the flow of public investments in irrigation and land development for the benefit of the under-privileged. The housing colony should be a happy blend of all communities, thus fostering emotional and social integration in the rural life. In planning the house sites, the case of other weaker sections and artisans of the rural area having no security of shelter should also be considered. The programme of construction or improvement of houses should include the provision of sheds for subsidiary occupations. Such mass construction activities would act as catalytic agent in generating integrated action for better living conditions, income and employment of the rural poor. The issues like clean drinking water, drainage, sanitation, roads etc. should form part of such planning unlike the fragmented approach in the past.

15.5.21 A number of special employment programmes were initiated for providing work to the agricultural labourers. But their total impact so far has touched only the fringe of the problem. Further efforts in this direction are essential. The subsidiary occupation programmes should be evolved out of a master plan covering the development of the physical resources of the village, setting up of farming activity by the labourers, creation of non-agricultural labour-intensive occupations like spinning, weaving etc. Certain lines of production like the printing of textile and weaving of multi-coloured textiles should be reserved exclusively for the household and small producer sector not using power, thereby providing scope for higher earnings, particularly in view of the export potential of the finished goods. Some aspects of subsidiary occupations and agro-based and rural industries have been dealt with in chapter 13. Of the long list of subsidiary occupations to augment income, priority should be given to development of livestock and dairying, development of poultry, vegetable growing, horticulture and fishery, and a package of subsidiary occupations suited to the traditions, environment and socio-culture of the people in that order. Arrangements for marketing the products of the activities should be made.

15.5.22 There should be a regular programme for enrolling rural youth for vocational training in skilled jobs, such as turner, mechanic, dye-maker, foundry man etc. After training they should be given facilities to set up workshops, either on individual or group basis, to cater to local needs. The programmes for agricultural labourers thought of in terms of quick and drastic action have been least productive of results. It is, therefore, necessary to consider programmes on a long-term perspective to evolve an approach capable of conserving and

cumulating the gains made without dissipating its energies on transient results. Phasing of the programmes over time is an important requirement for such an approach. The broad objective of the initial phase should be to bring the class of agricultural labourers within the reach of direct programmes to guarantee a minimum level of income along with acceptable minimum levels of nutrition, for which an effective network for distribution of foodgrains at reasonable prices would be necessary, and of welfare programmes of health, education and housing. The strategy in this phase should be to get poverty under control and impart certain minimal economic strength to the beneficiaries. The second phase is the institutional phase to nurture organisations and institutions among them. The rural works programmes may provide a good link between these two phases and facilitate the emergence of labour cooperatives, agricultural cooperatives and craftsmen's organisations, which should be nurtured and sedulously promoted in this phase. With certain minimal improvement in the economic well-being of the agricultural labourers, the conditions in this stage should be more favourable for the emergence of a comprehensive system for regulation of wages and working conditions and for offering social security to labourers. Ambitious measures like provident fund, unemployment and sickness insurance etc. will have to wait until a sound foundation for them is laid in the first phase. This does not however mean the postponement of the required legislation. Conditions are also likely to be more favourable for the training of agricultural labourers in subsidiary occupations in this stage, as the institutional infrastructure for such occupations is built up. While the programmes in the first phase will depend wholly on the initiative of the State and be implemented in the second, the initiative will gradually be assumed by the labourers with the State remaining as a partner in these programmes.

15.5.23 The third and the most difficult phase consists of programmes to change the structure of rural society, diminution of the concentration of socio-political power in the upper strata for effective protection from the local overlords. The success of these efforts will be in direct proportion to the extent of implementation of the earlier phases.

15.5.24 While the sequence of phases outlined above offers a broad visualisation of the progress of phasing and integration of programmes, the situation in any specific region may due to its peculiarities call for modification of the broad strategy. The industrial labour model would be the appropriate approach in areas having good potentials of development of horticulture and plantation type crops. This may be applicable also to the regions undergoing rapid technological change in agriculture. The backward and relatively isolated regions may need a reinter-

pretation of the phase-wise process to cover all population groups since there may not be any perceptible variation in the economic condition between classes.

15.5.25 The bonded labour is a typical situation. The restoration of the rule of law in those areas is the first prerequisite. The second ingredient is the observable presence of the State on the side of bonded labour with drastic and punitive measures against the land lords to loosen their grip on land and rural finance. The objective would be to throw in disarray the process of exploitation and remove the arrogance of power of the exploiters. The State Governments should post such officials in those areas as have an understanding of the problems and dedication. It should be ensured that the bonded slaves who have been freed do not again fall into the clutches of the moneylenders. Co-operative credit bank and panchayat thrift fund should make available to them interest-free loans to buy implements and inputs at concessional rates. Their children should be given special scholarships. A vigorous propaganda campaign should be launched to dispel their scepticism and to convince them the benefits.

15.5.26 Considering the vital role that information, statistics, monitoring and evaluation play in effective phasing and integration of programmes, the present system of collection and compilation of data on agricultural labour needs thorough reorientation to improve information output in all its major dimensions. The system of data should be based on the village level registration of agricultural labour households capable of providing both an appropriate frame for collection of sample data and for data analysis. The State Governments should ensure that every local authority maintains a register of agricultural labourers residing within its jurisdiction. Apart from the collection of basic statistics on a continuing basis, there should be evaluation studies to ensure that the resources devoted to the programmes effectively serve their objectives. A special cell should be set up in the Ministry of Labour or Agriculture & Irrigation to collect, compile and publish basic statistics relating to agricultural labourers continuously.

6 CONCLUSION

15.6.1 The recommendations made above, if effectively implemented, would go a long way towards creating a social structure which can liberate Indian agriculture from the shackles of medieval type of agrarian economy. Indian agriculture has to be put on the high road to development as a robust and dynamic system. This is not merely a technological task. It implies far reaching changes in property rela-

tions and socio-economic setup of rural India. The central objective is to enable the vast mass of cultivators and agricultural labourers, whose production potentials are being wasted today, to combine in full measure their manpower with modern technology, so that the whole agrarian economy rises rapidly to ever higher levels. The agricultural revolution has to reach the threshold of the humble cottage dweller. This can be done through a process of development in techniques linked up with the creation of maximum scope for its utilisation by the great mass of working peasantry. That the Indian agriculture has a bright future is a matter on which there can be no two opinions. Very few countries in the world have such magnificent natural resources and such immense manpower. The task is to combine these two, in a scientific and planned manner, in order to ensure maximum production with the largest measure of social justice. Agrarian reforms have to be directed essentially towards the realisation of that goal.

SALIENT FEATURES OF THE RECOMMENDATIONS MADE IN THE INTERIM REPORTS

1.1 The Terms of Reference of the National Commission on Agriculture envisaged *inter-alia*, submission of Interim Reports on the following items :

- (i) Agricultural research and extension.
- (ii) Administrative organisation for agricultural research and development.
- (iii) Employment potential of agricultural sector.
- (iv) Problems of small farmers and agricultural labourers.
- (v) Programmes for integrated area development.
- (vi) Any other items that the Commission may deem fit.

1.2 Besides the above broad subject-wise indications, there were requests for Interim Reports from the Planning Commission and the Union Minister of State for Agriculture. The Planning Commission suggested that the Commission should submit Interim Reports on a number of topics so that they might be considered in connection with the formulation of the Fifth Five Year Plan. The Commission also considered appropriate to pay special and immediate attention to certain priority areas on which urgent action was needed and also to obtain the Government's reaction to the Commission's proposals which could be taken into account in its final report. The Commission has accordingly selected 24 priority areas and submitted to the Government an Interim Report on each.

1.3 For purposeful understanding, the subjects dealt with in the Interim Reports have been rearranged into the following six broad groups :

- I. Inputs
 - II. Programmes for Small and Marginal Farmers and Agricultural Labourers
 - III. Area Development Programmes
 - IV. Prices, Marketing and Exports
 - V. Forestry
 - VI. Organisational Aspects of Research, Education and Training.
- The salient feature of the more important recommendations made in Interim Reports are set out in the following paragraphs :

I INPUTS

(i) Multiplication and Distribution of Quality Seed pertaining to High Yielding Varieties and Hybrids of Cereals.

1.4 The report deals with certain aspects relating to multiplication and distribution of quality seed of cereals and the responsibilities of various agencies engaged in multiplication and distribution in different stages, with a view to ensuring regular supply of quality seed in adequate quantities. It has laid down the responsibility for breeders' seed on the research institutions and the ICAR and for foundation seed of all-India importance on the NSC and for varieties of State importance on the agency or agencies to be designated by the State Government. With regard to certified seed, the Commission has advocated a multiplicity of agencies both for production as well as for marketing and has suggested their development by providing necessary incentives and facilities. The responsibility for assessment of the requirements of seed at various stages has been assigned to the production and marketing agencies subject to supervision, guidance and coordination by the State and Central Government. The Commission has emphasised the need for a close watch being kept on the performance of high yielding varieties in the field by the extension agencies.

(ii) Potato Seed

1.5 The Interim Report on Potato Seed suggests streamlining of arrangements for multiplication, storage and distribution of potato seed. The Central Potato Research Institute should be responsible for the production of breeder seed while the NSC and other well developed agencies for the production, storage, and distribution of seed material at foundation stage I. The Department of Agriculture/Horticulture in the State should be responsible for organising production at foundation stage II and for organisation and coordination of seed multiplication, storage and distribution at the certified stage in each State. The existing lacuna in storage and transport are also sought to be removed through suitable measures. It has also been recommended that the potato should be brought under the Seed Law and seed distribution should be organised in every State to ensure the supply of quality seed.

1.6 In order to prevent the introduction of new diseases and pests through continued import of seed material, complete banning of imports of foreign seed potato except for the material needed for new introductions where the imports should be made under conditions of

rigid quarantine procedures, has been suggested. It has also been proposed that a rigorous ban on a uniform basis should be imposed on the movement of seed potato within the country from all such areas which have developed diseases and pests and whose spread can pose a threat to the crop in other parts of the country.

1.7 The Commission has also recommended the creation of potato seed development councils in the States and at the Centre in order to review and make recommendations on matters pertaining to production, distribution, transport, storage, marketing, quality control, publicity and incentive aspects of the potato seed development programmes.

(iii) Fertiliser Distribution

1.8 In the context of shortfalls in consumption during the early seventies several aspects of fertiliser promotion and distribution and various measures for accelerating the consumption of fertiliser which is an essential input in scientific agriculture, have been outlined in this Report.

1.9 For providing the basis for organising production, imports and distribution of fertilisers, it has suggested setting up a special team for making a realistic assessment of the requirements of fertilisers for achieving the agricultural production targets set under the Fourth Plan has been suggested. Gearing up of internal production not only for meeting the increased requirements but also for achieving balanced application of nutrients, has also been recommended.

1.10 To ensure timely supply, steps have been suggested for streamlining distribution arrangements which include maintenance of intermediate storages near consumption centres by the Central pool, State Governments and fertiliser producers; easier movement by rail; construction of special road-head storage in areas not connected by rail; and supply to the interior and backward areas as well as difficult hill areas. A much larger promotional effort and soil analysis programme by the Government and fertiliser producers have been recommended for popularising fertiliser use. Revised distribution margins have been suggested to promote sales while special measures have been proposed by way of incentives to the cooperative sector to play its assigned role in the distribution system. In recommending the revised margins, care has been taken to ensure that the overall fertiliser price is not increased. Measures for ensuring easier and timely flow of credit, particularly to small and marginal farmers as well as retailers and quality of fertilisers have also been emphasised.

II PROGRAMMES FOR SMALL AND MARGINAL FARMERS AND AGRICULTURAL LABOURERS

(i) Credit Services for Small and Marginal Farmers and Agricultural Labourers.

2.1 In the Report on Credit Services for Small and Marginal Farmers and Agricultural Labourers, the Commission has suggested that the entire problem of agricultural credit needs of weaker sections should be reviewed with a view to providing an integrated agricultural credit service, *i.e.*, provision of credit along with organisation of facilities for the inputs and services required by the farmers and agricultural labourers to use the credit effectively. The agricultural credit service should cover not only the complete range of farm produce upto the marketing stage but also ancillary farm occupations such as those of rural artisans and craftsmen which provide services to farmers. It should also cover the requirements of credit, inputs and other services needed by animal husbandry, dairy, fisheries, farm forestry and other enterprises allied to agriculture.

2.2 The proposed agricultural credit service should have three constituents. Firstly there would be Farmers' Service Societies one for an area of about a block or even a smaller area in highly developed regions which might have as many branches/depots as would be required in the area, each branch covering a population of about ten to twelve thousand. Secondly there would be a union of these societies at the district level and functional district organisations for specific commodities wherever necessary. Thirdly, the Lead Bank of the district would assume leadership in the matter of organising integrated agricultural credit service for short, medium and long term loans.

2.3 The Farmers' Service Society might be organised at the level of a block or larger or smaller area as may be convenient depending on viability and the availability of services. This would be a registered cooperative body with bye-laws to ensure autonomy, efficient management and freedom from official intervention to provide an integrated agricultural credit service to the weaker sections of the population. The society would have its branches or depots to cater to the needs of its members at circle or equivalent levels to serve population groups of 10,000 to 12,000.

2.4 The Union of Farmers' Service Societies at the district level would mainly be for coordination of policies of the societies in the district and for mutual consultations. In addition, functional district organisations for specific commodities (milk, cotton, oilseeds etc.) could be formed at the district level where these are important. In other districts, the district Union of Farmers' Service Societies would

handle these functions also.

2.5 The Lead Bank in the district would assume leadership in organising integrated agricultural credit service for short, medium and long-term loans. It would have the overall responsibility for integrating the provision of farm credit with supply of inputs and services. Suitable linkages would be developed between the agricultural credit service and the institutions like land development banks, State agro-industries corporations etc.

2.6 The Commission has spelt out the detailed functions of the Farmers' Service Society, the District Union and Lead Bank with regard to the integrated agricultural credit service. It has also emphasised the importance of adequate training and supervision of the programme and suggested that the programme should be tried out initially in 81 SFDA/MFAL districts. After gaining some experience in these districts, the programme could be extended to other districts at a rapid pace.

(ii) Reorientation of Programmes of Small Farmers and Marginal Farmers and Agricultural Labourers Development Agencies

2.7 The Interim Report on Reorientation of Programmes of Small Farmers and Marginal Farmers and Agricultural Labourers Development Agencies, has suggested certain modifications in the existing schemes of Small Farmers Development Agencies (SFDA) and Marginal Farmers and Agricultural Labourers Agencies (MFAL) both from the points of view of production and of reduction of poverty so as to fit the programmes into the strategy of the Fifth Plan. It has recommended that the distinction between SFDA and MFAL projects should be given up and in future each Agency should have a compact area approach so as to cover the small farmers, marginal farmers and agricultural labourers in its area of operation.

2.8 The basic approach to the programme of small and marginal farmers has been to improve their crop production and to that end assistance would have to be directed towards development and utilisation of irrigation facilities, introduction of water harvesting techniques, land development and adoption of improved technology of farming both in irrigated and rainfed areas.

2.9 In order to ensure a more equitable distribution of limited groundwater, considerable emphasis has been placed on group-owned well system and community irrigation, wherever possible, for the benefit of small and marginal farmers. Through consolidation, the scattered holdings of small and marginal farmers may be brought together to form compact blocks to enable preferential irrigation by the State

Governments. The State programmes of irrigation development should therefore be undertaken in areas where surface water schemes or large-scale groundwater schemes are possible, so as to benefit substantially the small and marginal farmers. States would be required to take up on their own, programmes of water harvesting, soil conservation, etc. in the rainfed areas on a substantial scale.

2.10 In order that the farmers can take to improved farming practices and necessary technical guidance is available to them, the strengthening by State Governments of their extension network in the selected areas has been proposed. The Commission has recommended the extension of the programme to 160 agencies including the existing agencies and indicated the distribution of additional agencies among the States. Each agency on an average is expected to cover 70,000 small and marginal farmers preferably in the ratio of 1 : 3 to conform to the all-India pattern and to ensure that the programme should have the necessary tilt in favour of marginal farmers who are more numerous. As a result of the extension of the programme, about 11 million small and marginal farmers are likely to be covered during the Fifth Plan.

2.11 The Report has suggested the formation of as many Farmers' Service Societies as possible (recommended in the Commission's Interim Report on Credit Services for Small and Marginal Farmers and Agricultural Labourers) to make a beginning towards the development of an integrated credit structure. The investment programme and the much more intensive crop production programme, both under irrigated and dry farming conditions, would give increased labour opportunities to agricultural labourers.

2.12 Crop production alone may not yield incomes sufficient to raise many small and marginal farmers above the minimum need level. The Commission has, therefore, suggested the superimposition of subsidiary occupation programmes to be undertaken and financed separately on a substantial scale in such of the agency areas which have been identified for individual subsidiary occupations in its Interim Reports on Milk Production, Poultry, Sheep and Pig Production and on Sericulture. It has been recommended that the entire programme should be time-bound and target-oriented and implemented with a sense of urgency. For this programme, an estimated amount of Rs 241 crores would be required in the Central sector during the Fifth Plan. The State Governments should bear the cost of staff subsidy to institutions and the cost of staff of the agency, the staff of the Farmers' Service Societies and additional extension staff of the State Governments in the project area which would cost in all Rs 40 crores over the Fifth Plan period. The Commission has recommended the continuance of the subsidy of 25 per cent of the cost of investment to small farmers and

33-1/3 per cent to marginal farmers; at the same time, it has suggested certain modifications in the pattern of risk fund subsidies being given under SFDA/MFAL schemes.

(iii) Milk Production through Small and Marginal Farmers and Agricultural Labourers

2.13 The need and scope for augmentation of milk production by harnessing and developing the facilities available with the small and marginal farmers and agricultural labourers has been dealt with in the Report on Milk Production through Small and Marginal Farmers and Agricultural Labourers. It has been observed that even today milk production in the country is, by and large, in the hands of small producers and that the small and marginal farmers and agricultural labourers are already keeping milch animals. The farmers will be deriving multiple benefits by taking to milk production as a subsidiary occupation such as additional income, better nutrition through consumption of milk and milk products and more employment opportunities to the farm family labour which is otherwise under-employed.

2.14 Discussing the experience of the Anand Milk Scheme in Kaira district, the "Operation Flood" project and the State dairy schemes, the Commission has strongly recommended that the "Operation Flood" and State dairy schemes should take steps to ensure that at least one-third of the producers in the respective project areas come from the groups of small farmers and another one-third from marginal farmers and/or agricultural labourers. Further, assistance should be extended to atleast about 38,000 families belonging to this sector of the rural community to participate in the dairying programme in each of the districts covered by "Operation Flood" project and SFDA/MFAL districts. For this purpose the Indian Dairy Corporation and the State Governments should take up suitable programmes for strengthening the infrastructure, processing and other facilities of the existing dairy schemes for which the Central and State Governments should allocate sufficient plan finance. One of the measures suggested for ensuring increase in milk production, has been that the existing cows with the small and marginal farmers and agricultural labourers should be replaced by cross-bred progenies produced from these by the farmers themselves by organising an intensive cross-breeding programme through artificial insemination of local cows. These could be supplemented by supply of crossbreed heifers and calves through other sources by taking up special programmes for producing and rearing cross-bred heifers in suitable areas. Malnad in the south, western arid zones of

Rajasthan; grassland areas in Madhya Pradesh and Gujarat and hilly areas of Assam have been considered promising for this programme. Improvement in buffaloes through selective breeding in areas where they are popular with small farmers has also been stressed.

2.15 Important among the other recommendations are those for provision of financial assistance in the form of subsidies and loans for rearing heifer calves upto calving stage and arrangements for the supply of balanced feed and quality fodder and provision of required service. These services include insurance cover for milch animals, market facilities for milk, efficient animal health cover particularly for the control of foot and mouth disease, tuberculosis and brucellosis.

2.16 The programmes recommended envisage coverage of roughly 4 million families belonging to small and marginal farmers and agricultural labourers situated in about 107 districts in the country over a period of 8 to 9 years.

(iv) Poultry, Sheep and Pig Production through Small and Marginal Farmers and Agricultural Labourers for supplementing their income

2.17 The Report on Poultry, Sheep and Pig Production through Small and Marginal Farmers and Agricultural Labourers deals with the need and scope for augmenting the production of eggs and poultry, mutton and wool, and pork and pork products by harnessing and developing the facilities available with the small and marginal farmers and agricultural labourers. It has been observed that livestock rearing is practised as a by-product industry of the rural areas as a mixed farming complement alongwith crop production. Most of the people engaged in raising poultry, sheep and pigs in the rural areas belong to the category of small and marginal farmers and agricultural labourers. Any improvement in the productivity of this category of livestock through involvement of weaker section of the population can serve as a major instrument for effecting social change by improving the income of these people. Such a development would also offer great potentiality for providing employment to the producers and their family members as also to a number of village artisans. Increased production of eggs, poultry meat, mutton and pork in the rural areas would also lead to increased home consumption of these products by the producers, thus ensuring better nutrition to these people. It has been recommended that these development programmes should be formulated on a package basis providing for all inputs such as better breeding and feeding, proper management, disease control, credit and services such as extension, remunerative marketing and other facilities.

2.18 In working out the size of the poultry programme in each district the aim should be to provide marketing facilities besides ensuring benefits to as large a number of families as possible. In each district, at least 3,000 families of small and marginal farmers and agricultural labourers should be identified and enrolled under the programme, each selected family being assisted to start a poultry unit of 50 layers. It has been envisaged that the programme should be taken up in 167 districts covering about 5 lakh families.

2.19 Programmes have also been suggested for sheep development for improving the quality and productivity of sheep in regard to wool and mutton production by the small and marginal farmers and agricultural labourers. This is proposed to be achieved by gradual replacement of indigenous types of sheep by crossbred progenies having exotic inheritance to be produced by the farmers themselves and/or to a limited extent by supply of crossbred ewes and rams from other sources. One hundred and forty districts have been recommended to be taken up for the sheep development programme, at least 3,000 families being assisted in each district. This would help over 4 lakh families.

2.20 Since pig keeping is mainly in the hands of the backward communities and with tribals, such pig breeders deserve special assistance for improving their pigrearing practices. It has been recommended that the main plank for improving the economy of pig producers should be the replacement of indigenous pigs by crossbred pigs to be produced mainly by the breeders themselves. For this purpose, about 2,000 families of pig farmers should be assisted in each district for pig production programmes with the ultimate objective of covering 2 lakh families in about 100 districts.

2.21 For the production and supply of crossbred poultry, sheep and pigs to participant farmers and agricultural labourers, it has been emphasised that intensive crossbreeding schemes should be implemented in selected areas where such work has already been found popular and successful. It has been suggested that the farmers selected for these programmes should be allowed subsidy to meet the cost of capital expenditure such as purchase of stock, rearing upto production stage, housing, equipment, etc. A total subsidy of Rs 71.40 crores has been indicated for the Fifth Plan period.

2.22 The Commission has laid special emphasis on organising these programmes on cooperative basis mainly by small and marginal farmers and agricultural labourers. In view of their backwardness and low economic status, it has been recommended that Government and the credit agencies should liberalise the terms of financial assistance in the form of loans.

(v) Sericulture

2.23 The Interim Report on Sericulture deals with the development of mulberry silk which accounts for about 79 per cent of the total silk production in the country and which is concentrated in Mysore¹, West Bengal, Jammu & Kashmir and Uttar Pradesh. Keeping in view its beneficial impact on the economy of small and marginal farmers and modernisation of the industry the Commission has suggested a plan of action for the development of sericulture in certain identified districts of these major silk producing States. It has been suggested that instead of relying on the development of sericulture based on local races, a phased programme should be taken up for the introduction of bivoltine hybrids in the irrigated mulberry areas of Mysore, particularly Kolar and Chennapatna where the method of rearing bivoltine hybrids developed by the Central Sericultural Research and Training Institute could be followed.

2.24 The entire area under sericulture in Mysore should be covered during the Fifth Plan adopting the package of practices including new methods of leaf chopping, etc. developed by the Central Institute as these lead to less mortality of silk worms and a higher cocoon to leaf ratio. Cooperative chawki rearing-cum-reeling units should be set up in such villages where there are large groups of rearers. For raising mulberry under irrigated conditions, the small and marginal farmers should be given 25 per cent Central subsidy on digging of wells under the sericulture development programme to be financed by the Central Silk Board.

2.25 A crash programme has been recommended in West Bengal to test the suitability of heat resistant strains developed by the Central Research Station, Berhampore, for their introduction on a wide scale through a phased extension programme. With the evolution of new races, the farmers could get four crops consisting of two local and two bivoltine races in a year against four crops of local races at present.

2.26 Jammu & Kashmir State is concentrating on univoltine races which give only one brood per year. There is a need to undertake suitable research to identify the races of strains which can be introduced in the State so as to raise three broods in a year.

2.27 In regard to Uttar Pradesh, it has been considered desirable to introduce bush mulberry provided the number of broods can be increased to at least three against two at present in a year. For this purpose, immediate steps to carry out applied research, as also to develop bivoltine hybrids suited to the area in the State, have been suggested.

2.28 The Commission has felt that the entire process starting from the raising of mulberry to the disposal of the raw silk should be taken up on an integrated basis for the purpose of credit support and for developing an economically viable programme of sericulture. It has indicated that for achieving best results, functional cooperatives will have to be organised, which should get their finance from a single source for the entire chain of operations.

2.29 Endorsing the recommendation of the Price Stabilisation Committee set up by the Central Silk Board for a Raw Material Bank at the Central level with regional banks in the major silk producing States to ensure a fair price to the primary producer and supply of raw silk to the consumer at a stable price, the Commission has recommended that the Central Silk Board should assist in financing the operations of the regional banks as also in the setting up of the chain of testing houses required to operate the price stabilisation system.

2.30 Employment potential in silk industry at the end of 1978-79, at the all-India level is estimated at 4 million, of which rural activities are expected to account for 3 million. It is necessary to undertake a quick survey to collect more reliable estimates of employment in the silk industry in silk producing States.

(vi) House Sites for Landless Agricultural Labourers

2.31 The Interim Report on House Sites has advocated a production programme for landless agricultural labourers simultaneously with the measures for providing them with security of shelter. This will require a more comprehensive approach to the solution of the problems of the landless than merely providing them with house sites. It is only through the various subsidiary occupations that landless labourers and artisans can be brought into the main-stream of the productive process. Milk production, poultry keeping and vegetable gardening are some activities which can be undertaken on limited amounts of land and which will at the same time give reasonable subsidiary income to the families, besides generating increased employment and production.

2.32 The permanent right to a small piece of land where the agricultural labourer can build a shelter and follow an enterprise will also have an immediate effect on his social status and give him greater stability in life. This will also enable him to avail of assistance under various programmes like MFAL. Keeping this in view, modifications in the scheme of the Ministry of Works and Housing for the provision of house sites have been suggested. The Commission has further recommended that where land is available and space can be provided for the cattleshed or poultry or piggery or village industry alongwith

the site for a house, an area between 250 sq yards and 300 sq yards may be provided. Where adequate land is available and water can be provided for vegetable growing, an area of 500 sq yards has been recommended.

2.33 The house sites, the housing and the subsidiary occupation programmes have to be planned and coordinated effectively for concentrated development. The entire programme for providing house sites should be time-bound and completed in a phased and planned manner. In the next 10 years a programme covering 3 million landless Scheduled Caste and Scheduled Tribe families and another 2 million landless agricultural labour families belonging to other sections should be taken up for implementation. For this programme investment has been estimated at about Rs 22.5 crores for Scheduled Caste and Scheduled Tribe families and Rs 15 crores for other section of the landless annually to cover the cost of acquisition of land and development of house sites.

2.34 There should be a separate Rural Housing Board in each State to supervise the implementation of the programme. It is necessary that suitable assistance should be given to the landless agricultural labour for the construction of houses on the sites allotted to them.

III AREA DEVELOPMENT PROGRAMMES

(i) Modernising Irrigation Systems and Integrated Development of Commanded Areas

3.1 In its Interim Report on Modernising Irrigation Systems and Integrated Development of Commanded Areas, the Commission has observed that many of the older irrigation systems in the country do not meet the requirements of modern agriculture and call for modernisation. The existing irrigation projects which are not performing satisfactorily and which are susceptible of improvement are no better than incomplete projects and deserve serious attention. It is, therefore, necessary to undertake a comprehensive review of pre-plan and earlier plan projects. The review should not only include improvements to the engineering structures for safety and better regulation, but also several other aspects such as augmentation of supplies where deficient, efficiency in conveyance of water to the field, scientific application of water to crops and adoption of cropping patterns which would confer the maximum economic benefit. The review should be made by a team of specialists in irrigation engineering, agronomy and soils. The Irrigation Department should be responsible for the reviews and should

be assisted by the Agriculture Department in this task. Although it may not be practicable to carry out all the improvements on a project simultaneously on account of financial and other constraints, there should be a clear picture of the total improvement needed and the work on individual aspects should be so taken up as to fit into the overall plan of improvement. Guidelines for the reviews have also been suggested.

3.2 Discussing the main aspects of improvements needed in the existing irrigation systems, the Commission has laid stress on lining of canals and water courses. It has estimated that the total programme of lining, would need an investment of the order of Rs 600 to Rs 700 crores and would provide employment to the extent of more than a million man-years. The lining of water courses should be done at the project cost. The maintenance of lined water courses should be the responsibility of the State Government, while in the case of unlined water courses it should be done at the project cost. The maintenance of lined water courses should be the responsibility of the State Government, while in the case of unlined water courses it should continue to be that of cultivators.

3.3 Provision of adequate drainage in the irrigation commands is essential. The construction of drains up to 40 hectare block should be the responsibility of project authorities on the analogy of water courses. Like the field channels, field drains within the block should be constructed by the farmers themselves, the extension staff providing the necessary technical guidance in the matter.

3.4 Another important recommendation pertains to the need for integrated development of command areas of irrigation projects. The Central sector programme of financing marketing, storage and communication facilities in the command areas should be stepped up in the Fifth Plan.

3.5 Dealing with the pattern of financing of ayacut development programme, in which credit has been the main bottleneck so far, the Commission has made two alternative suggestions. The State can form a Land Improvement Corporation to take up the entire work of land shaping, construction of channels and drains as also ground-water units and recover the investment with interest from the produce per hectare on an agreed formula. Alternatively, it can adopt the concept of Farmers' Service Society which was recommended in the Commission's Interim Report on Credit Services for Small and Marginal Farmers and Agricultural Labourers. A comprehensive arrangement for long, medium and short-term credit, according to the Commission, is crucial for the success of the integrated commanded area programme.

(ii) Desert Development

3.6 The Interim Report on Desert Development deals with the Great Indian Desert situated in Rajasthan, Haryana and Gujarat. Early action is necessary to arrest the rapid deterioration of the desert area and a comprehensive 15-year programme has been recommended for its improvement and economic development so that much of the hardship arising there out of the drought and aridity can be mitigated permanently and lasting socio-economic improvements can be brought about in this under-developed region.

3.7 The integrated plan suggested by the Commission is designed to pay simultaneous attention to the development of water resources, forestry, animal husbandry and pasture development. Among important measures for utilisation of water resources are proposals for recasting of the Rajasthan Canal Project to exclude unsuitable areas and for construction of five lift canals to bring some more areas under irrigation to extend the benefits to a larger section of the community. The Report has urged early settlement on the question of sharing the river waters for expeditious development of water resources in Haryana and Gujarat.

3.8 Groundwater exploitation is intended mainly for domestic and industrial use. For maximising the utilisation of the scanty rainwater, use of water conservation techniques like *khadins*, *bandhis* and *adbandis* on a larger scale has been proposed. Advocating judicious use of available water resources, the Commission has suggested alteration of the cropping patterns to utilise about 30 per cent of canal command areas for growing fodder crops to meet the requirements of animal husbandry in mixed farming and large-scale production of quality seeds for which the area is eminently suitable.

3.9 A large scale programme of tree plantation, development of shelter-belts and wind-breaks and rejuvenation of vegetal cover by utilising the water available in the early stages of command area development has been recommended with a view to controlling the effects of hot winds, wind erosion, sand blowing and sand casting on arable fields. Tree and grass cover has been suggested on shifting sand dunes in canal command areas and on those which pose a threat to habitations, roads and railways. The plantation programme is also to be geared to meet the requirements of fuel and small timber locally and to prevent over-exploitation of the existing resources and digging of *phog* roots which cause deterioration of the desert by loosening the soil.

3.10 The economy of the desert area should be mainly animal husbandry oriented. A major thrust of the programme is on preven-

tion in large measures of the present nomadism of the cattle breeders and sheep owners for their social development and for systematic breeding of the livestock. The programmes suggested also include planned breeding for improving the productivity of cattle and sheep. In canal command areas, dairy development through setting up of additional milk collection and milk chilling centres and milk products factories has been proposed.

3.11 In other arid areas, the major emphasis should be on sheep development for which wool shearing and grading centres and wool and meat marketing arrangements have been suggested. Adequate extension support for preliminary processing of wool is necessary for maximum utilisation of wool locally by the cottage industry and for creating more employment opportunities.

3.12 Programmes have been recommended for augmenting feed and fodder resources in the area to ensure supply of adequate nutrition to the animals. For this, proposals have been made for large scale development of pastures, regulated grazing to prevent over-use and creation of grass reserves and fodder banks for supply of hay in scarcity years. It has been estimated that the various programmes recommended would require outlays of about Rs 397 crores in Rajasthan including Rs 297 crores for completing Rajasthan Canal Project and developing the commanded area, Rs 16 crores in Haryana and Rs 10 crores in Gujarat in addition to other items of development under the plan in the desert areas. The programmes should be properly phased over a period of three plans and should be given adequate organisational support to ensure timely and effective implementation.

(iii) Whole Village Development Programme

3.13 In its Interim Report on Whole Village Development Programme, the Commission has recommended a programme of village development based on community approach and action. The essential elements of this programme consist of consolidation of holdings, overall land development plan, maximising water control and moisture preservation in dry areas, maximising irrigation support and cropping programme for the village for best use of irrigation and for ensuring best control of irrigation and drainage.

3.14 Measures for social justice form important components of the programme. These include distribution of land to the landless, minimum wage rates for agricultural labour, States' contribution towards risk in irrigation development, technical expertise, consolidation of holdings and protection to sharecroppers, subsidies and various financial requirements. The subsidies which are allowed for such

programmes are not to be given to the individual beneficiaries of the programme but made available to the implementing authorities to cover risks in the programme, build up a fund for margin money to enable them to avail of institutional loans and for development of the section which earns the subsidy for the community.

3.15 The Commission has drawn attention to the crippling influence of indebtedness on the small and marginal farmers and recommended mitigation of this burden through State support so that the benefits of development do not pass into the hands of money-lenders. The implementing authorities at the village level are to settle and pay off the loans from the money-lenders and recover the amount from the cultivators in suitable instalments. For this purpose, the State is to provide to the implementing authorities sufficient funds at nominal interest or no interest. The creation of a nucleus fund at the village level to advance consumption loans has also been proposed.

3.16 The Commission has suggested the establishment of Project (Implementation) Committees at the village level with representation from the village society for securing the necessary agreements from the villagers and handling the programme. A Project (Implementation) Union, to which the committees at the village level will be affiliated, has also been suggested in the interest of uniformity of policy and action. The Central organisation will organise and supervise the programme of development, services, supply and marketing for mutual benefit and will receive and use, in the programme, funds received from the Government. The committees as well as the union will be registered societies and have separate legal entities.

3.17 Wherever voluntary organisations are available and capable, they should be entrusted with the implementation of the programme. Among other measures proposed are coordination committees at State or district level to coordinate the activities of various departments and agencies and a central committee under the Planning Commission for periodical reviews at the national level during the pilot stage of the programme.

3.18 Initially, four pilot projects have been proposed to be taken up in the States of Bihar, Orissa, Tamil Nadu and Uttar Pradesh in the last year of the Fourth Plan. These projects will require about Rs 2 crores for the programme, of which a sum of Rs 30 lakhs has been recommended to be provided for in the Central sector in the last year of the Fourth Plan and the balance during the Fifth Five Year Plan. An expansion of the programme on pilot basis has also been proposed in the Fifth Plan for which a lump sum provision of Rs 10 crores has been suggested.

(iv) Some Important Aspects of Livestock Production in the North Eastern States.

3.19 In its report on Some Important Aspects of Livestock Production in the North Eastern States, the Commission has highlighted the importance of livestock production in the life and economy of the people of this region covering Tripura, Manipur, Mizoram, Nagaland, Arunachal Pradesh, Meghalaya and Assam and stressed the urgent need for improving the quality and productivity of livestock.

3.20 Meat constitutes an important item of the diet of the people of this area. The livestock population in the region is fairly large and the important species reared are cattle, pigs and poultry including ducks. It is a high density area in regard to pigs having about 16 per cent of the country's total pig population. Since there are immense potentialities for rapid development in the field of livestock production, the Commission has recommended that a perspective plan on livestock development should be drawn up for each State and for the region as a whole, on a long range basis. Once the requirements of the development plan are worked out for different time perspectives, it would become possible to plan measures for the production and supply of improved livestock in adequate numbers and at the appropriate time to support the development programmes.

3.21 For improving the quality and productivity of cattle, a planned crossbreeding programme using suitable exotic breeds like Jersey, Holstein, Brown Swiss, Red Dane should be undertaken. Expansion of the existing purebred cattle breeding farms and the establishment of additional cattle farms are also necessary. The importance of mithuns which are found in large number in the States of Arunachal Pradesh and Nagaland has been stressed and special studies with a view to exploring the possibility of crossbreeding mithuns with local cattle for increased meat and milk production and draught capacity have been proposed in the Report.

3.22 An integrated programme of piggery development which envisages the setting up of farms with purebred exotic breeds of pigs, pork processing plants and improved breeding of pigs should be undertaken in the rural areas. For areas, where there are still certain traditional prejudices against rearing white breeds of pigs, suitable black exotic breeds should be obtained.

3.23 Adoption of a scientific breeding programme at a large Central poultry farm for developing improved strains of poultry suitable for these areas, strengthening of existing poultry farms in the States and improved poultry breeding in rural areas with purebred strains and crossbred birds have been suggested. Duck rearing is quite popular

particularly in the States of Tripura, Manipur and Assam. More emphasis should be given for development of ducks in this region and a programme of crossbreeding local ducks with exotic breeds should be taken up on a pilot basis.

3.24 The establishment of a Fodder and Grassland Station in the high ranges has also been suggested. A techno-economic feasibility study on developing compounded feed mixing industry in this region has also been suggested. Setting up of a large Regional Biological Products Station for undertaking manufacture of adequate quantities of all common vaccines and diagnostic agents to meet the requirements of the entire region has been proposed.

3.25 Projects sponsored by the North Eastern Council should be regional in nature and should primarily serve the interests of a part or whole of the region and that the funds of the North Eastern Council should not be used for duplicating or replacing the State schemes.

IV PRICES, MARKETING AND EXPORTS

(i) Agricultural Price Policy

4.1 The Interim Report on Agricultural Price Policy, contains approach to price policy for both food and commercial crops and the entire package of support price, procurement/purchase price procurement and distribution of cereals and such aspects of food policy as are relevant to price policy. The Report also deals with the arrangements for advising the Government in the matter of agricultural price policy.

4.2 The need for assuring remunerative prices to the farmers with a view to encouraging investment in agriculture and adoption of modern technology has been emphasised in the Report. At the same time, it has been stressed, the price policy should facilitate growth with stability and should be formulated keeping in view its impact on the economy as a whole.

4.3 The Commission has not favoured reliance on price as the principal mechanism for augmenting production in a situation where shortages run across the board, since such a policy will only add to price rise without yielding higher output. It has felt that for increasing production and the farmer's income, the main emphasis should be on technological improvement and availability of crucial inputs.

4.4 The major aim of the price policy should be to correct distortions arising out of imperfections of the market. It should seek to safeguard the interest of the farmers when prices fall and protect the consumers when prices rise.

4.5 Minimum support prices should be fixed for the principal crops, both food and commercial crops, and they should be announced well before the sowing season to facilitate investment decisions by the farmers. The price should be fair and cover the cost of production as also include a reasonable profit. While the existing practice of fixing a uniform all-India support price should continue, a small differential in price may be allowed in specially high cost areas.

4.6 In dealing with the basis for price fixation, the Commission has noted that the wide variation and other limitations of the available cost data do not provide a firm basis. It has proposed the development and use of an index number system for the principal crops to take into account year to year changes in the costs of production. Till the index number system is developed, the Agricultural Prices Commission should make an informed judgement about fair support price, after taking into account available information and consulting its Advisory Panels. However, the price fixation should take into account the fluctuations in input prices.

4.7 Regarding the procurement price of cereals, the view has been taken that it should be related to the purchasing capacity of the vulnerable sections of the society whom the public distribution system should principally cater for. The price, although higher than the support price, should not be much above the issue price minus the cost of distribution plus, at best, a small element of subsidy.

4.8 The enlargement of the public distribution system to cover, on a regular basis, particularly vulnerable rural areas in the country, such as drought prone and flood affected areas has been suggested. For adequate functioning of the distribution system, procurement of about 12 per cent of cereals production on an average, for the next few years has been recommended. This implies the procurement of 12 million tonnes in 1975.

4.9 The system of compulsory graded levy on producers, millers and hullers has been preferred as the major operational instrument for procurement of cereals, with reliefs, as may be deemed necessary, for the smallest producers. Due allowance has also to be made for difference in output levels between irrigated and unirrigated areas. The Commission has stressed the need for legal sanction, adequate administrative arrangements as well as political backing for effective implementation.

4.10 The preparation, every year, of a National Food Budget after taking a realistic view of the requirements and availability has been recommended. The rates of levy in each State would require to be fixed on the basis of its procurement target. Other established forms of procurement like pre-emptive purchase could be considered provided

the State concerned is able to fulfil its procurement target.

4.11 Once the levy is collected on the basis of the target, the farmers will be free to sell the remaining quantum in the open market and the State can remove restrictions on movement; but the question whether a State has fulfilled its obligations should be decided by the Centre and not by the State concerned.

4.12 Regarding commercial crops, the Agricultural Prices Commission, apart from recommending support prices for the major ones, should watch the prices of other commodities and recommend, wherever necessary, support prices and the measures required to make them effective. An Agricultural Commodities Corporation of India should be established for price support and other operations in respect of commercial crops other than cotton, jute and tobacco.

4.13 The existing three-Member Agricultural Prices Commission should be expanded to a four-Member Commission in order to enable it to take a more informed view on various issues. One of the Members should be an agricultural scientist experienced in problems of production. Another Member should be a non-official with understanding of agricultural production and consumer problems.

4.14 In order to provide a better range of consultation, the appointment of a Technical Panel, consisting of agricultural scientists, administrators, economists and statisticians, to advise the Agricultural Prices Commission has been suggested. This will be in addition to the existing Advisory Panel of Farmers.

(ii) Certain Important Aspects of Marketing and Prices of Cotton, Jute, Groundnut and Tobacco.

4.15 In the Interim Report on Certain Important Aspects of Marketing and Prices of Cotton, Jute, Groundnut and Tobacco the Commission has made a broad assessment of some aspects of the marketing structure for four important commodities, i.e., cotton, jute, groundnut and tobacco, in the light of likely trends in production and demand over the coming years and the prevailing patterns of market arrivals. These commodities were subject to considerable year to year fluctuations in production and prices, which were harmful to sustained production effort, and that the middlemen through their hold on the market mechanism continued to exploit the farmers. Various measures to facilitate marketing of these commodities and to stabilise their prices, have been suggested in the Report so that, on the one hand, the cultivators are assured of reasonable returns on their investment and, on the other, the economy benefits from stable prices and supply.

4.16 The Agricultural Commodity Corporation of India, the estab-

blishment of which has been proposed in the Interim Report on Agricultural Price Policy, should deal with the marketing aspects of oilseeds. The proposed Tobacco Board should be entrusted with the responsibility of stabilising the prices of various grades of tobacco. All the commodity corporations (i.e. Cotton Corporation, Jute Corporation, Tobacco Board and Agricultural Commodity Corporation) should be equipped with adequate financial and physical resources to enable them to gain a commanding position in the respective commodity marketing. These corporations should act as holding agencies by acquiring and operating buffer-stocks and help in moderating the price variations and maintaining an even flow of supplies for the industrial/foreign trade sector. Further, they should work on import-export basis. For discharging these responsibilities, they should be given a measure of flexibility and free-hand for determining the magnitude and timing of their operations, specially in respect of imports.

4.17 Credit policies of the Reserve Bank of India should be so designed as to help these corporations to establish themselves. The corporations should develop cadres of functionaries who can undertake commercial operations without the support of any fiscal concessions.

4.18 High priority needs to be given to the provision of essential infrastructure such as market yards, warehouses and auction floors and creating adequate grading facilities to ensure proper marketing of these crops. Regulated markets should be opened in new areas being brought under cultivation of these crops and regulated markets lying dormant for want of funds should be reactivated.

4.19 Introduction of auction-cum-tender system in the regulated markets with the right to pre-empt any lot at the highest price reached in the bid has been suggested in the case of cotton and jute. In the case of tobacco introduction of auction sales on a universal basis has been recommended as essential. Secret bid tender system followed in certain parts of Tamil Nadu and Karnataka has been commended in the case of groundnut.

4.20 The Ministry of Industrial Development should take steps to encourage indigenous manufacture of new types of gins and presses to meet the processing requirements of extra long, long and finer varieties of cotton. To meet the immediate needs, their import has been suggested.

4.21 The Commission has recommended that minimum support prices should be fixed in the case of tobacco, particularly for VFC and bidi types.

(iii) Certain Important Aspects of Selected Export-Oriented Agricultural Commodities

4.22 In its Interim Report on Certain Important Aspects of Selected Export-oriented Agricultural Commodities, the Commission has covered five commodities, namely, tea, coffee, tobacco, pepper and cardamom which together account for about 40 per cent of the total exports of agricultural commodities of the country. The Commission has attempted to make a broad assessment of the export possibilities of these commodities in the light of the likely trends in production and internal demand over a period of time. An endeavour has also been made to identify some of the countries where a high level of demand could emerge for these commodities. Various measures to facilitate export or to mitigate the influence of factors inhibiting the export drive in respect of these commodities have been discussed in the context of forecasts of the future demand.

4.23 In regard to tea, a country-wide assessment of its export possibilities, not only to traditional buyers but also to the new markets, should be made on a continuing basis. The Commission observed that the internal demand for tea has been kept at a low level by fiscal measures to adjust exports to production. The internal demand for tea worked out by the Commission is much higher than that envisaged at present and this suggests an aggressive production programme and a reorientation of the existing approach. The first essential step is to collect, by means of survey, the basic data in respect of classification of tea plantations into good, medium and others as also the extent of surplus land suitable for growing tea through the cooperation of various tea planters' associations and the concerned State Governments. Good plantations with efficient management and high yields should be allowed to expand the area in the normal way. Medium plantations should reach the level of good management before they are allowed to expand. Wherever feasible, additional capital and technical assistance necessary to improve yields of medium plantations should be provided. In other plantations, which include a large number of small holdings, a scheme on the pattern of Tea Development Authority in Kenya could be developed and taken up in the cooperative sector.

4.24 Special stress has been laid on the problems of tea estates in Darjeeling, rehabilitation of sick plantations, promotion of internal consumption and lowering of cost of production as also the initiation of a programme of long term development of tea industry. Financial assistance to each plantation should be based on its actual performance and not on State/regional average yields. The Commission has also suggested the criteria for rendering financial assistance to various types

of tea plantations.

4.26 Plantations in the size range 2 to 10 hectares can be made viable if coffee in the world markets should be made and the scope for developing new markets should be explored. With proper propaganda and retail marketing facilities, the internal demand will also be very much higher than at present envisaged. The programme for production of coffee should take note of these factors.

4.26 Plantations in the size range 2 to 10 hectares can be made viable if they are provided proper input services and adequate extension support. The problems of small coffee growers of Kerala deserves urgent attention. The Coffee Board should take the leadership in organising Farmers' Service Societies in plantation areas where small holders are thickly congregated. Further, in the new areas coming under plantations and in some of the potential areas identified by the Board, small holders' coffee plantations may be systematically developed on the pattern of the Tea Development Authority in Kenya. For rehabilitating small plantations, the Coffee Board should, after a quick survey, arrange to complete, within 2 or 3 years, gap filling in such plantations with clones of high yielding varieties of coffee. Properly run coffee plantations should get the working capital from banks and the development funds of the Coffe Board should not be allowed to be locked up in working capital.

4.27 In regard to tobacco, with the general consumption trend towards the low nicotine content of Virginia variety the tobacco grown on light soil areas with irrigation should find favour from the marketing point of view. It is also essential to safeguard the interests of tobacco producers by making an inroad into the world trade in filler tobacco especially when India has got varieties which could find a place in the world markets provided they are offered at competitive prices. It is desirable to have a second string of exports in the public sector which could cut across the monopoly of foreign concerns. The proposed Tobacco Board should be entrusted, *inter alia*, with the task of studying the preferences of the traditional buyers for tobacco with low nicotine content grown in light soil areas and taking steps necessary for improving the export prospects of filler tobacco.

4.28 In regard to pepper, the programme for popularisation of Panniyur-I hybrid, which is not only high yielding but is also suitable for export from the quality angle, should be given high priority. A suitable plan of action for eradication of wilt disease should be expeditiously taken up by the Ministry of Agriculture and Irrigation in consultation with concerned States. For stepping up exports of pepper, it is essential to collect detailed information about the qual-

ties popular in the importing countries and the ruling prices as also the sources of supply so that the competition can be planned accordingly. Due weight should be given to foreign specifications in the Indian grading system so that production of pepper of lower pungency becomes possible in the country. The requirements for meeting the export demand for high pungency pepper are small and could be met without difficulty. The two main considerations in encouraging production should be the yield and quality acceptability for the bulk of the export market. In view of the demand from certain countries for processed pepper products, the economics and possibility of exporting them should be examined.

4.29 As far as cardamom is concerned, infestation by *Katte* disease is responsible for low yields and urgent steps are necessary to control this disease by uprooting all the affected plants. The Cardamom Board should undertake a survey of the plantations so as to assess the area infested with *Katte* disease. The area under replantation programme should be stepped up substantially. Suitable packages of practices for adoption by the small farmers need to be devised. The system of growing cardamom as a mixed crop with arecanut and pepper in protected valley locations should be adopted. Efforts should be made to evolve denser varieties of cardamom for export to the Scandinavian countries. Attention should also be given to the manufacture of processed products of cardamom.

V FORESTRY

(i) Production Forestry—Man-made Forests

5.1 In its Interim Report on Production Forestry—Man-made Forests, the Commission has noted that the present yield from India's forests is dismally low and has advocated a rational development and utilisation of forestry resources in the country. There should be a change-over from the present conservation-oriented forestry to a more dynamic programme of production forestry with a view to meeting the requirements of wood and wood-based industries. Considering the advantages of aggressive man-made forestry programme, the future production programme should concentrate on clearfelling of valuable mixed forests, mixed quality forests and inaccessible hardwood forests and planting this area with suitable hardwood and fast-growing species yielding higher return per unit area. The resulting produce from the clearfelling areas is to be utilised in wood-based industries by locating additional units wherever necessary.

5.2 A programme of clearfelling and planting of about one lakh hectares annually in the current decade in the accessible hard-wood forests and mixed forests of valuable and low quality as well as intensification in the coniferous forests should be undertaken to meet the future requirements. In the next decade, the annual felling area should be enhanced to enable exports on a moderate scale. The programme of clearfelling and plantation would require an investment of Rs 242 crores during the years 1974-80 of which the investment during the Fifth Plan is estimated at Rs 173 crores. During the next decade an investment of Rs 306 crores would be required.

5.3 The production forestry and the industries programme suggested in the Report are self-generating and will pay back adequately. Illustrative models showing the economics of the production forestry have been worked out as guidelines for the formulation of the programmes by the States.

5.4 While emphasising commercialisation of the production forestry, the need for a proper linkage between forestry production and utilisation has been stressed. To this end, the establishment of wood based industries has been suggested. In the current decade, an investment of Rs 815 crores would be required in industries. Of this, the investment in paper and pulp industry would be Rs 611 crores. In the next decade, an investment of Rs 1,187 crores would be needed in industries of which paper and pulp would account for Rs 979 crores. In view of the sluggish performance by the private sector in the matter of investment, the States may have to invest between Rs 160 to Rs 340 crores in paper and pulp industries in the public sector during Fifth Plan after allowing for investments by the existing public sector enterprises.

5.5 The programme for clearfelling, plantation and maintenance should be taken up from the beginning of 1974. In view of the magnitude of the investment involved in the entire programme and paucity of plan resources, the future production forestry programme should be financed from institutional sources. The Agricultural Refinance Corporation should be the agency to directly finance the production forestry programme by changing its Statutes suitably. In case this is not possible, a Central Forest Credit Corporation has to be organised. The industries programmes have to be financed from industrial lending agencies such as IFC, ICICI and IDC. In order to avail of the institutional financing, State forest corporations are to be set up in each State to handle the programme. These Corporations could borrow money on the basis of equity capital consisting of land and standing timber. For this, the State Government should

transfer the areas under the programme to the corporation and take only the average revenue of the last three years from these areas and leave the rest of the income from clearfelling to support the programmes. These corporations might either take up the supporting paper and pulp industries directly or from subsidiaries to handle the industries programmes.

5.6 In order that the work can be taken up immediately, each State which takes up the programme should establish a Planning and Project Analysis and Estimation Cell which will be the forerunner of the corporation. The setting up of Fruit Utilisation Cell in the Chief Conservator's Office and establishment of an Industrial Cell for the industries programme have been proposed. A Planning Cell has also been suggested in the Union Ministry of Agriculture and Irrigation to help the States in formulating and implementing the production forestry programmes.

5.7 In dealing with the pricing policy, there has to be an incentive for the change-over from the low-cost low-yield forestry to commercial high-investment economic forestry. The price for the produce has to be so fixed as to pay for the cost of clearfelling and plantation and leave a profit. A rational pricing policy for bamboo and pulpwood has also been recommended.

5.8 The programme suggested is expected to provide annual employment of 50 million man-days (or 250,000 man-years) mainly in the rural sector of the hilly and backward regions where most of the unexploited forests are located. There will be an additional employment in industries. The massive labour requirement will mean organising and training a labour force of considerable magnitude for which action has to be taken by the States.

(ii) Social Forestry

5.9 The Interim Report on Social Forestry deals with farm forestry, extension forestry, re-forestation in the degraded forests and recreation forestry and has suggested suitable action programmes during the Fifth Plan. The programme is designed to bring social benefits to the population in the form of increased supply of fuelwood (thereby releasing cowdung for manure), small timber and fodder as well as of recreational facilities.

5.10 There should be extensive plantations on the bunds and boundaries of the fields of the farmers for which the forest extension units would develop the nurseries for the supply of seedlings. A pilot scheme for development of farm forestry should be taken up in the Central sector in 100 selected districts—60 districts in areas with

advanced agriculture where fuelwood and timber are scarce and 40 in dry and arid zones.

5.11 Mixed forestry should be taken up on waste lands, panchayat lands and village commons in drought prone areas for which a survey of waste lands and village panchayat lands has been proposed for preparing land-use plans based on a village or a group of villages as a unit. Development of fodder and grass is to be an important component of mixed forestry so as to increase their supply and benefit the weaker sections of the population who may be encouraged to take up animal husbandry programmes. Emphasis has, therefore, been placed on the organised production and distribution of seed involving local farmers. It has been suggested that an area of one lakh hectares should be covered through pilot projects of mixed forestry in the Central sector.

5.12 With a view to preventing damage to agricultural crops, agricultural lands, roads, etc. through wind erosion, shelter belts should be established in hot and arid areas. The programme is to cover on lakh hectares distributed among the States of Haryana, Punjab, Rajasthan, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Mysore (now Karnataka) and Maharashtra with 50 per cent Central assistance. In addition, planting of trees on lands on the sides of roads, canal banks and railway lines as a commercial investment should be undertaken with an annual target of not less than 8,000 km of planting. Moreover, 3 lakh hectares should be covered by reforestation programmes in degraded forests with a view to increasing the supply of fuelwood and small timber and preventing unauthorised removal from and easing the pressure of valuable commercial forests. To supply fuelwood and small timer for agricultural implements at fair rates, State subsidy has been proposed for the first 15 to 20 years.

5.13 The State Government should make a study of the problem of recreational needs of the urban areas and dedicate some forests or establish tree groves near such areas for recreational purposes. Moreover, green belts, around towns and cities, wherever necessary, should also be created.

5.14 Considerable emphasis has been laid on appropriate training in extension methodology and technology for officers selected for implementing the programme. Agricultural universities are also to include in their syllabi a course in social forestry for the agricultural graduates. A large number of field demonstrations with the participation of panchayats, cooperatives and village school staff have been suggested for popularising social forestry. Field assistants are to be recruited from the local pepole in the programme areas to secure

involvement of villagers. All social forestry programmes should be executed by engaging local labour and not through contract system.

(iii) Forest Research and Education

5.15 In its Interim Report on Forest Research and Education, the Commission has observed that the existing base of forest research in India is not sufficiently adequate to implement the programmes based on the approach outlined in its earlier two Interim Reports on 'Production Forestry-Man-made Forests' and on 'Social Forestry'. Attention has been drawn to the need for substantial research support to the forestry programmes in the context of fast changing technology in the field of management and utilisation of forests and the need for adoption of dynamic forestry practices. The steps needed to remove the organisational, technical and financial constraints and to re-vitalise forests research and education in the country have been indicated in the Report.

5.16 The Commission has divided forest research into three groups, viz., (a) forestry and biological research; (b) industrial and utilisation research; and (c) forest management and operation research, including statistics, economics and marketing research. It has also indicated the types of organisation necessary to carry out basic, applied and adaptive research at the local, regional and national levels. It has been suggested that facilities required to carry out basic and applied research bearing on forests should be built up in the agricultural universities. Other universities may also organise research on forest problems to the extent feasible and possible. For this purpose, the State Forest Departments should provide the necessary facilities and support. The State Forest Departments may, if necessary, establish properly equipped and staffed research institutes in order to tackle applied research problems of a local nature. In addition to basic research, the Central Forest research organisations should take up applied research of regional and national importance, and also assist forest research organisationally and financially in the States having inadequate research base. The industrial research which requires a large capital investment and special expertise and equipment should be the responsibility of the Centre. At present, there is no well organised unit for industrial design to expedite commercial exploitation of proven pilot experiments, and this should be made good. The Central Government should also set up, where necessary, multi-disciplinary regional forest research institutes. In addition, there might be centres to take up specific problem oriented research projects.

5.17 The agricultural and other universities which are to undertake forest research could introduce forestry as one of the subjects in the under-graduate course.

5.18 Gradually, the scope of forest education could be widened to graduate, post-graduate and doctorate degree courses in forestry, as qualified staff and other facilities needed for research become available. In order to create more opportunities for employment of forestry graduates, under-graduate course could be broad-based, so that a wide choice of careers is possible. Moreover, forestry could be included as one of the elective subjects in the competitive examination for the Indian Forest Service; besides preference to the university graduates in forestry can be given in the recruitment of the State Forest Service officers and Forest Rangers. There should be an integrated approach to research and education, by which teachers are actively involved in research and vice-versa. The Forest Research Institute, Dehra Dun, because of its long tradition of research and teaching, should be developed as an academic institution for teaching in the forestry both at the under-graduate and post-graduate levels.

5.19 In order to promote forest research and education within the existing administrative structure and also in order to achieve the desired degree of coordination between Central and State forest research institutes and universities, a high-powered Council of Forest Research and Education (CFRE) should be set up in the Union Ministry of Agriculture, with the Cabinet Minister of Agriculture as its Chairman. One of the tasks of the CFRE would be to have a realistic assessment made of technical manpower, including each category of specialisation needed at professional levels in forest management, research and industries.

5.20 The universities and forest-based industries besides the Central and State research organisations, should be more thoroughly involved in the identification of problems and formation of programmes for inclusion in the five year plans. Once the programmes are formulated and approved and allocation of funds is made, the institutes/centres should have full authority for incurring expenditure.

5.21 The total funding for forest research and education in the five year plans should not be less than 1 per cent of the forestry and logging sector's contribution to the gross domestic product. The possibility of levying an R&D cess on industrial products of forest corporations and forest-based industries or a cess or a surcharge on sales tax on forest produce should be explored as a source of finance for forest research and development.

VI ORGANISATIONAL ASPECTS OF RESEARCH, EDUCATION AND TRAINING

(i) Some Aspects of Agricultural Research, Extension and Training

6.1 In its Interim Report on Some Aspects of Agricultural Research, Extension and Training the Commission has delineated the role of agricultural universities and State departments in regard to research, extension and training. It has recommended strengthening of fundamental and applied research and has made suggestions for funding of such research. Fifty Professorial Chairs should be created for fundamental research in agriculture and sciences basic to agriculture. Some of these will be Chairs of Excellence, to attract outstanding scientists.

6.2 Agricultural universities should be responsible for fundamental and applied research while the responsibility for adaptive research should be that of the State Department. Similarly, responsibility for extension should be with the State Departments while the role of the universities should be limited to extension education. The set up in the universities should be reorganised by forming divisions having teaching, research and extension components in each one of them. The departments should be strengthened by providing specialists at district and tehsil levels.

6.3 In the sphere of training of farmers as well as senior and junior staff members of the departments, the respective roles of State departments and agricultural universities have also been specified. Setting up of training centres at the rate of one in each district to provide long and short duration training facilities in various subjects to farmers and their sons has also been recommended.

6.4 Finally, the Commission has suggested constitution of an apex body in each State under the Chairmanship of Minister for Agriculture with the Vice-Chancellor of the university, the heads of concerned departments and Agricultural Production Commissioner as Members to exercise overall supervision and to ensure harmonious working of the universities and departments.

(ii) Organisational Aspects of All-India Coordinated Research Projects.

6.5 In its Interim Report on All-India Coordinated Research Projects, the Commission has examined in considerable detail the organisational aspects of these Projects financed by the Indian Council of Agricultural Research (ICAR) and, on the basis of this examina-

tion, has recommended re-allocation of emphasis and re-distribution of responsibilities in the overall administration of agricultural research among the ICAR, agricultural universities, Central and State research institutes and State departments. Only research problems, either of fundamental or applied nature, in the sphere of agriculture (including horticulture, animal husbandry, fishery, forestry, etc.) which are important from the national point of view should be sponsored by the ICAR. Further, the formulation of coordinated research programmes and of methods of implementing them require a careful assessment of all categories of research that is being done by the scientists in the agricultural universities and Central research institutes and of the projects and schemes being implemented there. The ICAR should set up small teams which would study, in depth, the scope and the need for further research work and the nature and extent of funding needed by the agricultural universities and the Central research institutes in regard to these items. The funds to be given to the universities should be made available by way of block grants.

6.6 The coordinated research projects should broadly satisfy the following criteria :

- (i) The projects should envisage problem-oriented applied research of known knowledge under different broad agro-climatic conditions;
- (ii) the problems to be studied should be of national importance and they may be applied to a single discipline or may be multi-disciplinary;
- (iii) the problems should be such as to warrant the concentration of efforts of a number of scientists on a single problem; and
- (iv) the projects should aim at developing recommendations in the shortest time for increasing production.

6.7 There should be simplified and speedier procedure for the sanctioning of coordinated projects, specially those at the State department/agricultural university level. Also, some flexibility should be provided in the allocation of funds.

6.8 There is need for testing the new technology on a large scale, the primary purpose of such testing being to identify the operational problems of the transfer of technology under a given socio-economic milieu. This type of operational research should be taken up by the agricultural universities/Central research institutes in close coodination and collaboration with the development agencies.

(iii) Organisation and Functions of the Commodity Development Councils and Directorates.

6.9 In its Interim Report on Organisation and Functions of the Commodity Development Councils and Directorates, the Commission has analysed the functioning of the councils and the directorates in order to make them more effective. The Commission has advised against unnecessary proliferation of councils and recommended that at the all-India level, the concept of commodity development councils should be confined to crops which have a substantial industrial and/or export angle. While separate councils for cotton, oilseeds, tobacco, lac, jute, sugarcane and horticulture should continue, the existing councils for cashewnut, coconut, arecanut and spices are to be combined into one council for plantation crops having common problems of production and marketing. The councils for rice and pulses have been proposed to be abolished. No development council need be set up for wheat or millets.

6.10 The Report has delineated the functions of the councils and suggested for them a dynamic role in examining the problems of marketing, processing, storage and transport of the commodities and their trade and pricing and advising the Government thereon. Each council should have a small committee called the Trade, Pricing and Export Committee for examining these problems in depth. All the development councils should set up technical committees to review the various technical problems of production. A close link between the universities, research organisations and the technical committees has also been envisaged.

6.11 In the interest of better coordination in development and marketing, State development councils should be set up to deal with crops which are dealt with in the Central development councils. The functions of the State councils will be the same as those of the Central councils. In addition, they will have specific functions to consider the recommendations of the Central councils and adapt them to local conditions wherever necessary and watch their implementation. Each State should also have one or more commodity councils for the major crops in the region in addition to those dealt with by the Central commodity councils. These councils will have representation covering all the interests whose active cooperation is necessary particularly of the progressive farmers.

6.12 The Commission does not envisage a directorate for commodity development for those commodities for which there will be no Central council. The directorates which will continue will have to take full responsibility for the analysis of marketing, trade

and price data of the commodity. They are also to continue to plan, and coordinate the development programmes of the respective crops and act as the secretariat of the concerned development councils; but they are not expected to involve themselves in the implementation of the programme in the field, which is a State responsibility. Like the concerned councils, the Directorates of cashewnut, coconut, arecanut and spices are to be clubbed together.

6.13 The crops, in which there will not be any Central development council and the directorate, will be handled departmentally in the Crops Division in the Central Ministry of Agriculture. In order to review these crops as well as the residuary problems which are not covered by the development councils and the directorates, an annual conference of the State and Central Ministers has been proposed. Strong units should be created in the Ministry of Agriculture and in the State Directorates of Agriculture for important crops which require special attention. In particular, the setting up of such units in the Crops Division in the Ministry of Agriculture for pulses and rice has been suggested.

(iv) Establishment of Agro-Meteorological Divisions in Agricultural Universities.

6.14 In the Report on the Establishment of Agro-Meteorological Divisions in Agricultural Universities, the Commission has suggested that for an intimate knowledge of weather in relation to crop production, animal husbandry, fisheries, forestry, pests and disease control and related operations, the science of weather should be taught, studied and applied in all agricultural universities and such other institutions as are suited for the purpose. The Commission has recommended the immediate establishment of a Division of Agro-Meteorology in each of the agricultural university and selected institutions, each Division being responsible for research, teaching and extension activities related to agricultural meteorology in an integrated manner. The principles of staffing and financing the Division have also been suggested.

(v) Soil Survey and Soil Map of India

6.15 In its Interim Report on Social Survey and Soil Map of India, the Commission has recommended that expeditious measures should be taken to prepare the soil map of India in the scale of 1 : 1 million within a reasonably short period, say, 10 years, for which the requisite number of soil survey parties should be organised in

accordance with the specific requirements of the State and the Centre. All development programmes in agriculture should be dependent on a scientific knowledge of the basic soil resources. A study of the present status of the soil survey in the country has revealed that there are considerable gaps in the soil survey, soil map and correlation and classification of the differentiated soils. There is a great necessity for preparation of scientific inventory of the soil resources of the country to form a basis for crop planning, intensive agriculture and a number of non-farm activities.

6.16 For accelerating the soil survey work, aerial photographs should be made available at least for the non-sensitive areas. It has also been recommended that for the purpose of carrying out soil survey mapping, correlation, classification and interpretation on a standard pattern, necessary training facilities already available with the All India Soil and Land Use Survey Organisation should be strengthened.

6.17 For the purpose of unification of soil survey work throughout the country, a close liaison between the Central and the State soil survey organisations is imperative. For this, coordination committees should be activated or set up at the State and national levels. State Coordination Committees should utilise the existing data on soil survey for land use and crop planning after due interpretation.

ERRATA

ABRIDGED REPORT

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		row 2		
237	Section 1	Heading	SYSTEM	SYSTEMS
238	6.1.4	13	fields	field
241	6.1.10	4	value crops	high value crops
242	6.2.2.	2	account	accounts
243	6.2.5	16	to durum	on durum
244	6.2.8	6	berseem	berseem

(1)	(2)	(3)	(4)	(5)
246	6.2.12 (iv)	4	water lodging	water logging
247	6.2.13	1	problem	problems
251	6.3.2	9	boon	boron
252	6.3.3	29	measure	measures
254		6	horsegram	former
258	6.3.23	1	Virgina	Virginia
258	6.3.25	4	position	position on
260	6.3.28	11	India	India should
261	6.3.31	1	ramine	ramie
268	6.4.11	1	seion	scion
274	6.4.31	4	given	give
275	6.4.32	3	tackle	tackle on
281	6.4.55	3	eucalyptus	eucalyptus
293	6.6.16	Heading	Shrubs	Shrub
299	6.7.11	2	universtally	universally
301	6.8.2	9	hony	honey
311	7.1.14	27	hiefer	heifer
312	7.1.16	last	ammals	animals
318	7.1.36	6	obviously	physiology
330	7.3.10	10 from bottom	scale in	scale is
335	7.4.2	1	useful reliable	useful and reliable
336	7.4.3	16	(CFDA/MFAL)	(SFDA/MFAL)
337	7.4.7	1	Government has	Government
342	7.4.24	4	chisksexing	chicksxing
344	7.4.33	7	landling	handling
350	7.5.15	18	Rsearches	Resarches
354	7.5.28	4	houroes	horses
355	—	Para No.	7.5.35	7.5.34
355	—	Do.	7.5.36	7.5.35
355	—	Do.	7.5.37	7.5.36
366	7.7.8	7	residue's	residues
366	7.7.12	2	racion	rations
371	7.8.13	6	imported ducks....	"Delete"
374	7.8.23	7	Khaki Camp	
378	7.8.42	—	laso	also
			"add" (after major killer of)	imported ducks and wiped out several consignments of Khaki Camp—
381	7.8.50	last	AIIH&PM	AIIH&PH
382	—	Para No.	3.9.5	7.9.5
387	7.9.25	1	Corporations Committees	Corporations/ Committees
394	8.1.19	12	Reverine	Riverine
396	8.1.25	1	feels	feeds
396	8.1.25	10	ecoconomical	economical
398	8.1.29	6	warms	farms
399	8.1.34	last	egective	effective

(1)	(2)	(3)	(4)	(5)
400	—	Para No.	8.3.36	8.1.36
400	8.1.36	4	acquaculture	aquaculture
401	8.1.39	2	Do.	Do.
401	8.1.41	7	devlopment	development
402	8.1.43	2	acquaculture	aquaculture
402	8.2.1	5	comparision	comparison
403	8.2.2.	3	ing a growth rate	ing an annual growth rate
404	8.2.3	18	contribution	contribution
406	8.2.7	7	prespective	perspective
406	8.2.8	5	grounuds	grounds
412	8.2.30	3	estimates, only	estimates. Only
413	—	Para No.	2.3.31	8.3.31
414	8.2.36	5	mies	mics
417	8.3.1	3	maangement	management
417	8.3.2	5	phase with a	phase while a
420	8.3.11	5	carbs	crabs
425	8.4.11	4	sardin	sardines
425	8.4.11	6	sardine, mackerel....in the areas	should examine the question of increased utilisation of the installed
426	8.4.15	8	trawelers	trawlers
427	9.0.2	4	importance, seve-	importance. Seve-
448	9.2.65	2	has evolved	has been evolved
457	9.3.22(v)	2	dwingling	dwindling
460	9.4.6	4	to plant up	to plant
462	9.4.16	7	defficiency	deficiency
464	9.5.5	4	The FRI also	The FRI should also
465	9.5.9	7	1927 Act been	1927 Act has been
469	9.6.10	2	distinck	distinct
474	10.1.4	12	will	all
476	10.1.12	1	has been	had been
477	10.1.14	6	verietaal	varietal
482	10.2.6	1	P ₂ C ₃	P ₂ O ₅
482	Do.	1	K ₂ C	K ₂ O
487	10.2.22	last	plants	plans
488	10.2.24	2	resort imports	resort to imports
488	Do.	4	shortfall	shortfall
495	10.3.7	2	I must not	It must not
496	10.3.10 (ii)	5	practices	practices
497	10.3.14	6	on	by
501	10.3.30	5	11M	11M
502	10.3.35	8	ben	been
503	10.3.35	1	1971-72 rose	1971-72 it rose
503	10.3.38	1	chemicals of the	chemicals at the

(1)	(2)	(3)	(4)	(5)
505	10.3.44	6	protectoin	protection
512	10.3.71	4	DPPO &S	DPPQ&S
513	10.3.73	4	and officer	an officer
513	Footnotes	1	man : 9 ·07 hp	man : 0 ·07 hp
513	Do.	2	tillbr	tiller
513	Do.	2	deisal	diesel
517	Table 10 ·1	Col. 2— Total	129 ·62	"delete"
517	Do.	Col. 3— Total	"blank"	129 ·62
517	10-4-18	3	periority	priority
525	10.5.19	2	in any sector	in every sector
531	11.1.9	1	problems on	problems of
532	11.1.10	5	everything	everything
533	11.1.15	1	tech-	teach-
534	11.1.17	4	to a communicate	to communicate
539	11.1.32	7	accross	across
543	11.2.5	1	tiffic	tific
543	11.2.6	15	and	the
545	11.2.10	11	vary	varied
546	11.2.13	3	economies	economics
548	11.2.20	8	The	To
558	11.2.46	9	fisheries on a regional basis	fisheries and that too on a regional basis,
585	12.3.2	1	its	the
587	12-3-8 (xv)	3	exports if	exports;
588	12.3.10	3	Coid	Coir
593	13.1.4	1	behaviourial	behavioural
594	13.1.6	4	Aggregates	Aggregated
597	13.1.18	6	fuel/wood	fuelwood
599	Table 13.2— Footnote	3	"from main	from "main
600	13.1.24	4	objective	objectives
600	13.1.24	4	provided	provide
601	13.1.27	11	of	or
604	13.1.37	1	aim	aims
604	13.1.37	9	eases	cases
605	13.2.1	7	research	research,
607	13.2.9	6	cover	cover is
608	—	8	Department	Departments
609	13.2.17	3	transportation	transportation facilities
613	13.2.33	1	sysmbiotic	symbiotic
615	—	5	programmes	programme
617	13.2.48	4	and	an

(1)	(2)	(3)	(4)	(5)
621	Appendix 13.1	Sub-heading	Western Ghat High Region	Western Ghat Hill Region
625	14.1.1	6	objective	objectives
626	14.1.6	3	indivision	individual
636	14.2.16	3	marketing,	marketing
641	—	1	producers'	producers'
642	14.2.35	5	operation	operations
645	14.2.46	6	bing	being
656	14.3.24	2	directorate	directorates
659	—	6	Production	Production,
661	14.3.38	6	professional	professional guidance
661	14.3.40	2	hierarchy	hierarchy
661	14.3.40	5	and	any
662	14.3.46	2	importan	important
			tresponsibilities	responsibilities
663	14.4.2	4	sation	sations
664	—	5	Grammen	Grameen
664	14.4.6	3	activites	activities
667	—	4	National	Nations
667	14.5.3	10	to	for
672	Appendix 14.2	Title	CONCEPT	CONCEPTS
672	Do.	Item 13, line 2	less	more
673	Do.	Item 17, line 1	include tanks and reservoirs which	aim at providing gravity flow
674	15.1.3	2	increased	increasing
677	15.1.12	8	reform	reforms
681	15.2.11	7	withholding	withholding
684	15.2.18	14	work,	work
686	15.3.8	13	farmer	farmers
686	15.3.9	7	peasant	peasants
686	15.3.9	11	loosing	losing
687	15.3.10	11	these	those
687	15.3.11	6	labour	lower
688	15.3.14	12	liabilites	liabilities
699	15.4.15	6	legislation	legislations
701	15.4.22	1	benetfis	benefits
701	15.4.22	11	agronomst	agronomist
702	15.4.26	4	in experience	experience
703	15.4.30	4	benetfis	benefits
706	15.5.6(i)	5	during	between
708	15.5.8	3	This and	This, and
708	15.5.9	7	mere	more
713	15.5.25	last	them	them about
713	15.5.26	2	or	of
713	15.5.26	8	data and	data and the broad socio-economic con- text of this class

(1)	(2)	(3)	(4)	(5)
717	1.9	5	Plan has been suggested.	Plan.
719	2.9	last	ot	to
721	2.14	9	dairing	dairying
724	Footnote	—	Karnatka	Karnataka
726	2.33	10	section	sections
727	3.2	9-11	should be done.... courses it should continue	should continue
732	3.25	3	that the funds	the funds
732	4.3	2	machanism	mechanism
734	4.15	9	that the	the
737	4.26	1	4.26. Plantations .....made	4.25. The forecast of demand for Indian Coffee
737	4.26	14	coffe	low economic con-
739	5.2	3	valuable and low quality	tent and valuable forests
739	5.4	12	durng	during
740	5.5	5	from	form
741	5.12	14	timer	timber
742	5.16	12	supoprt	support
746	6.11	10	Thees	These
746	6.12	1	and	any
747	6.15	1	social	soil
748	6.16	3	recommened	recommended
748	6.16	4	very	vey